HEATING & VENTILATING

AIR CONDITIONING

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FOR DECEMBER, 1937

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For Engineers and Contractors Controlling the Design, Specification, Installation and Maintenance of Heating, Ventilating and Air Conditioning.

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Associate Editor
CLIFFORD STROCK
Assistant Editor
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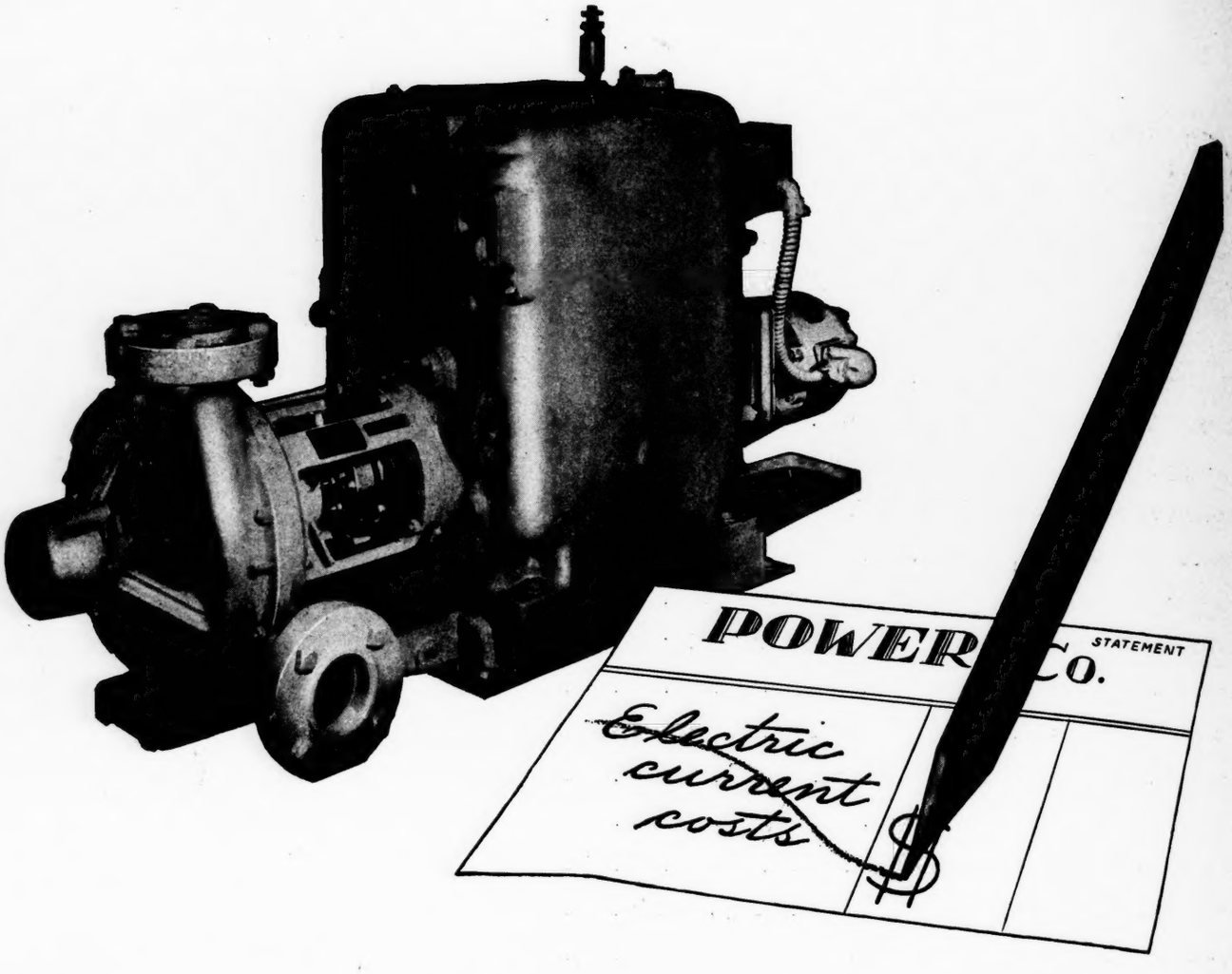

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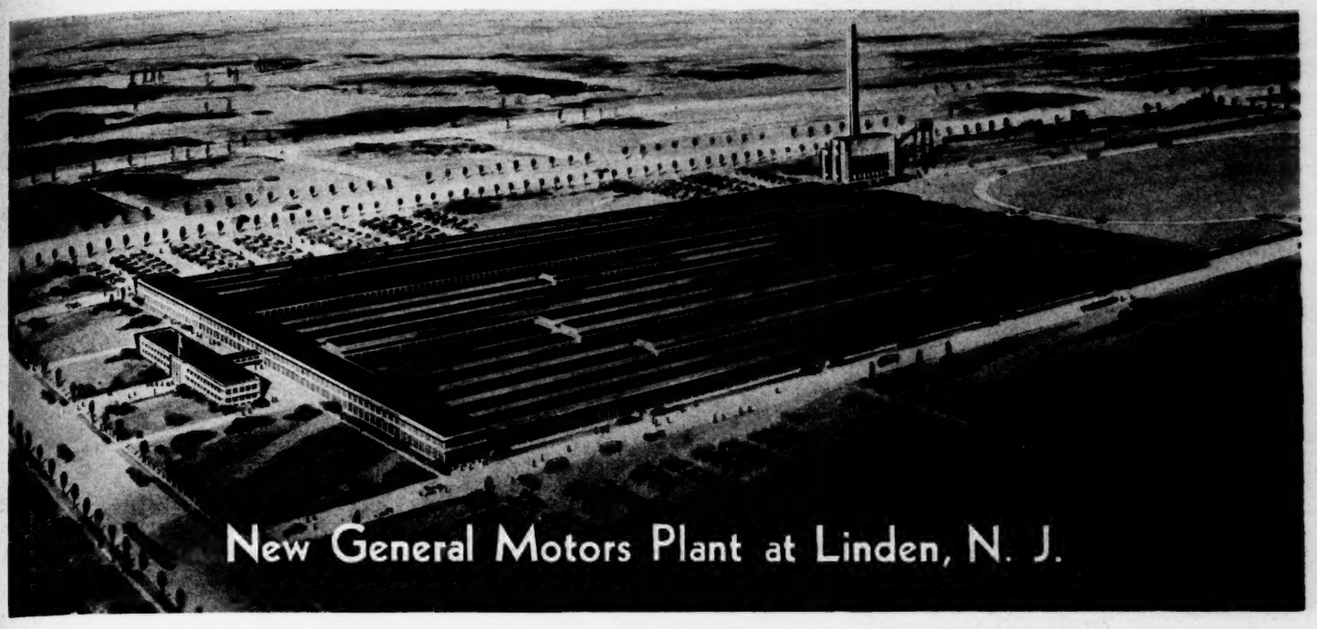
Heating a 23-Acre Room



New General Motors Plant at Linden, N. J.

By F. O. JORDAN†

Performance with a capital P is demanded in a modern industrial plant and the heating plant must perform just as well as any other part. The new assembly plant of General Motors at Linden is one of the largest and most up-to-date of industrial construction projects. The 23 acre, single room, factory building and the general office building each demanded separate and distinctive treatment. In this article the features of the factory building only are described; in a future issue the author will deal with the general factory office. You will want to learn what one of the large designing organizations of the country decided should be put into this modern plant.

HEATING a 23-acre field confined by a steel and masonry structure into one room—a room with a 25-ft. ceiling—is not exactly an everyday problem for the average heating engineer.

Yet this was only a part of the problem requiring solution before winter health and comfort could be assured for the workmen in the new plant of the General Motors Linden Division recently erected at Linden, N. J.

Major Problems

To the complications naturally encountered in creating draft-free comfort in a single enclosure of such lofty ceiling and almost limitless floor space were added the following unusual demands:

A—The possible addition of mezzanine floors under any of the 25-ft. high monitors is contemplated, so that parts of the area of the plant may at some time be covered by these mezzanine floors intervening between the ground floor and main roof. Demanded by the owner was a heating system which would serve with equal effectiveness the present mezzanine-less building and such ground floor and the new small mezzanine floors when and if this elevated floor should be added at some future time.

B—Many radical alterations in present arrangements of manufacturing equipment to suit changing models and methods are not only possible, but probable. Such changes in location of special process work may require more heat or less heat in certain areas, while the introduction of outside air may be required in other areas because of future spray booths being located there.

C—No heating piping or equipment was permitted in the clear space below the structural roof supports.

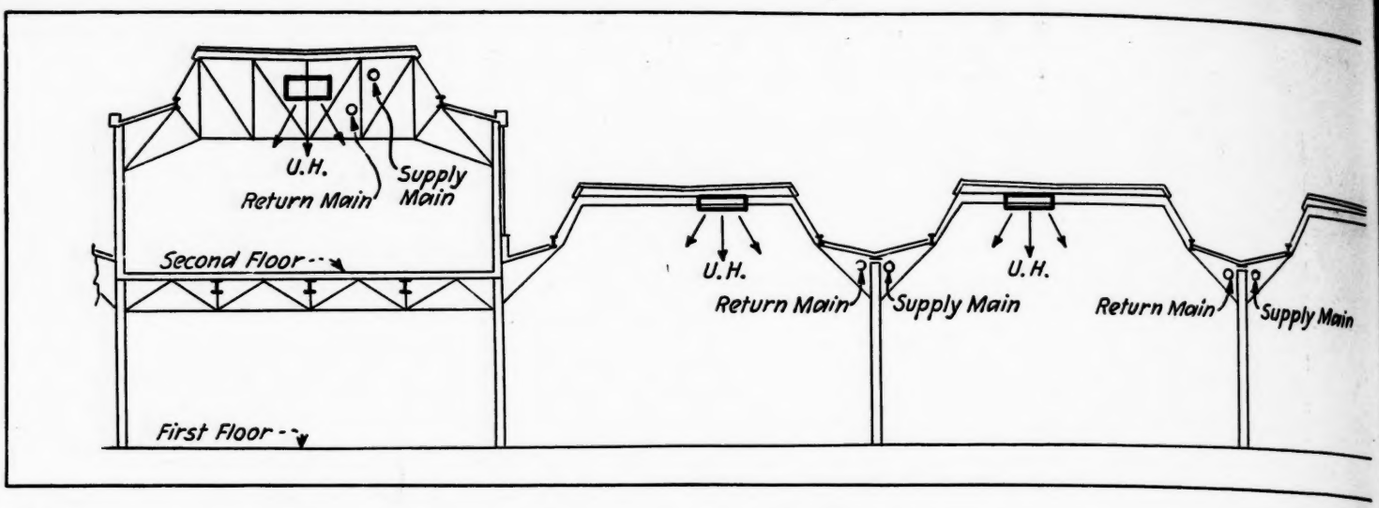
Compliance with this last requirement was particularly difficult because of the unusual construction employed. This construction was peculiar in that the girders running at right angles to the monitors are deep I-beam sections with solid web, bent to form the cross contour of the monitors and the low intervening roofs between them. To permit this bending, a portion of the flange of the I-beam at the inside of the bend was cut away, and a notch of suitable angle was cut from the web so that after the bending of the outer flange to the required angle, the cutaway ends of the inner flange and web were made to butt against each other, all ready for welding. This solid plate construction left no space available for the threading through of pipe lines as in the case of open lattice girder construction.

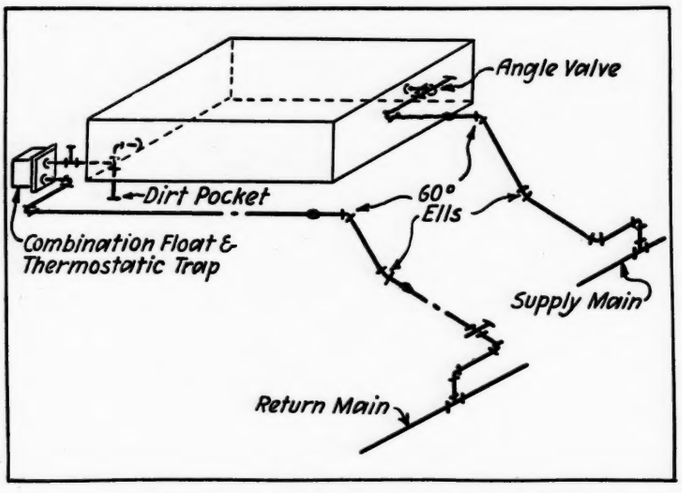
Type of System

The first problem attacked was the selection of the type of heating system most suitable for the peculiar requirements of the factory building.

A forced circulation hot water heating system, using long overhead pipe coils in general, with wall radiators

†Consulting Engineer, Detroit.





(Top) Cross-section through part of factory building. (Below) Detail of typical unit heater connections.

at outside walls has proved to be economical in first cost. Operation has proved satisfactory also, because the water temperature applied to the system can so readily be varied to suit outside temperatures.

Such a system was not advisable for the Linden Plant, however, because of the difficulty and expense which would be encountered in making extensive changes in the heating system to suit major alterations or additions to the building itself, or to the manufacturing processes carried on in the building. Furthermore, it would be impracticable to heat the occupants upon the floor by means of pipe coils located some 25 ft. above them, as well as impossible to make such an installation within the space requirements of the owner.

A direct radiator system using steam as its heating medium would have presented even greater difficulties.

A hot blast type of central heating system was out of the question because no space was available for such huge ducts and equipment as would have been required.

Ceiling Unit Heaters Chosen

Thus the quest automatically narrowed itself down to the selection of a system employing unit heaters. Even the use of floor type unit heaters was not advisable because it handicapped the full use of area for production work. Therefore the overhead type of unit heater was decided upon.

Load Estimates

In making the heating load estimates, conventional methods and data were used, except that the designing engineer has found by long experience that he can safely use a factor for computing roof losses about 20% smaller than is customarily used. However, on unit heater installations, he makes a practice of selecting unit heater capacities about 20% in excess of the computed loads as a safety factor against the time when the unit heater grows old and its finned heater surfaces may become partially fouled.

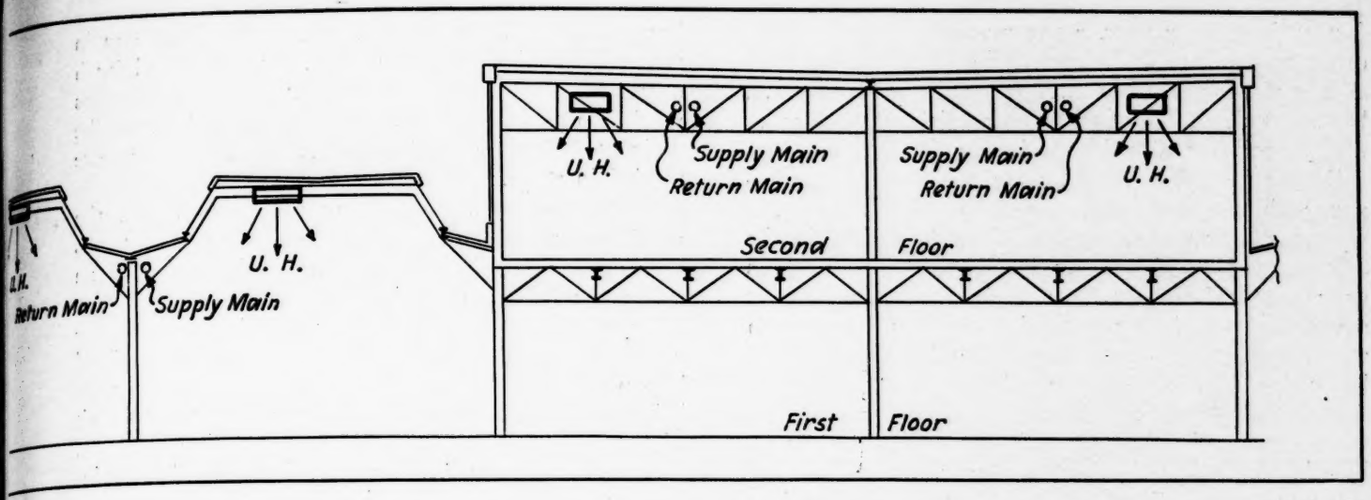
Load estimates in the factory building were based upon the following assumed air changes: Inside bays, ½ air change; outside bays, 1 air change; corner bays and bays with large doors, 1½ air changes.

For carrying the heating load on the factory, more than 200 unit heaters were installed. The total air circulating capacity of these unit heaters is in excess of 1,000,000 c.f.m., while their total heating capacity is approximately 50,000,000 B.t.u. per hr., based upon air entering the heaters at 70F.

Steam Supplied at 175 Lb. Pressure

Steam is generated at the boiler house and fed at 175 lb. gage into a steam main leading to the factory building. Upon its entry into the factory building, the 175 lb. steam heating main delivers steam into a main of approximately 1800 ft. in length through an automatic pressure regulating valve which reduces the steam pressure to 40 lb. The size of this main has been selected so that under maximum load conditions the pressure drop throughout its entire length of approximately three-eighths of a mile is about 10 lb. Thus, the operating steam pressure upon the unit heaters varies from 30 lb. to 40 lb. gage depending upon their position in the circuit. Higher steam pressures than 30 to 40 lb. have been found to be inadvisable because of the tendency of flashing to steam of condensate in the return system because of its high temperature.

Because of the relatively high operating steam pressure at the unit heaters, it was possible to install smaller units than would have been required at lower pressures. The relatively high steam pressure, and the much greater pipe line pressure drops made possible by its use, both result in much smaller piping than is necessary at lower operating pressures. When the 200 odd unit heat-



ers and the thousands of feet of mains are considered, it may be seen that these economies were well worth while.

Air Distribution is Regulated

The air deliveries of all unit heaters are so regulated, that discharge air temperatures in no case exceed 135F.

With the exception of a few small disc type unit heaters installed in toilet rooms and similar locations, all units are of the multiblower type discharging air at sufficient velocity at a downward angle of approximately 45F to maintain comfort in cold weather at the floor, which in most cases is some 25 ft. below. The blower type units are of the horizontal suspended, or of the overhead inverted type, as required by the surroundings and locations of the respective heaters.

In general, these heaters are suspended from the roof structure at the highest points of the high monitor bays. Their extended outlets are so directed that the proper proportion of their air discharge will reach the main floor.

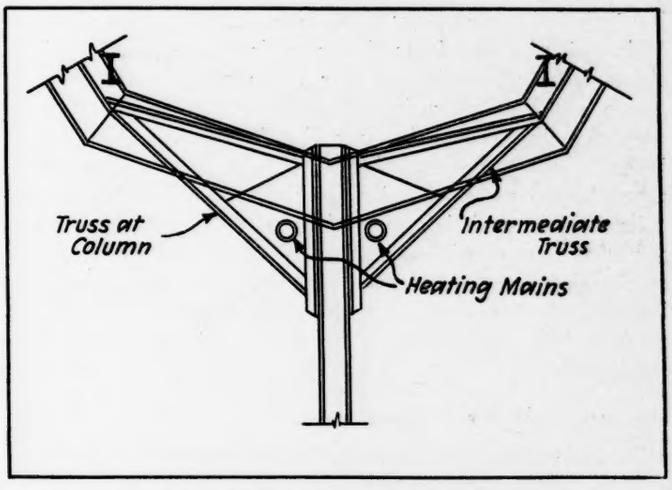
With the exception of the areas adjacent to outside walls, practically all heat loss is above the future mezzanine level, so that but little heated air will be required below. Furthermore, adjustments in direction of air flow that might be required in a given location may easily be obtained merely by changing the angle of the extended outlets, several of which exist on each unit.

The direction of discharge of all unit heaters in the factory proper has been selected to produce a slowly rotative effect of the entire air-mass within the building, as this arrangement has been found to aid in even temperature distribution and in elimination of local stagnation in buildings of this type. The spacing of the units in direction of air flow is 80 ft. apart where adjacent to outside walls and 100 ft. apart in other locations.

Thermostatic Control

Each unit is operated under control of its individual thermostat, a manual three-position controller being installed by means of which operation of the fan may be set for thermostatic control, for continuous running, or at "stop." No automatic control is provided for the steam supply.

All thermostats are located on columns adjacent to the units which they control, care being taken to select locations which are neither in dead air pockets, nor in the direct blast from the unit heater.



Detail showing location of heating mains in trusses.

Expansion Bends Used

With the great length of the mains, and the comparatively high steam pressures employed, expansion bends were installed to prevent undue strain on connections and fittings. The probable expansion under the conditions at hand was estimated at approximately 2 in. per 100 ft. of run. Because of the limitation in space available for these bends it was found necessary to limit the lengths of the bends by spacing them closer together than would have been otherwise necessary. Because of this limitation, bends were installed in the mains at about 160 ft. centers.

Condensate is Returned

Condensate from the heating coils in the unit heaters is discharged through combination float and thermostatic traps, especially designed for service at the steam pressures employed, into overhead return mains to flow by gravity to condensate pump and receiver units whence it is discharged back to the large condensate receiver located above the boilers.

Direct Radiators in Factory Offices

For the factory offices which are located within the

factory building proper, a two-pipe steam system with direct wall radiation and gravity returns was selected as being better suited to office heating than unit heaters, because unit heaters tend to be productive of a more drafty condition than is satisfactory for offices.

Due to the higher environmental temperature requirements of the seated worker as compared to the worker who stands or walks, heating often is required in the office areas in mild weather, when the factory workers are more comfortable with no heat other than the heat resulting from their own activities. For this reason steam for heating the office areas is taken from the exhaust steam mains which are in service all year because of process requirements, thus allowing the live steam main to be shut off in the boiler house when no heat is required in the factory proper.

Steam for the direct radiation in the factory offices is taken from the exhaust steam main, and reduced to 2 lb. Condensate from direct radiators is discharged through thermostatic radiator traps to a condensate pump and receiver unit.

In the first aid department in the factory building is an all-year air conditioning system of the central type. This system includes air circulating fan, heating coils, cooling and dehumidifying coils, filters, and distributing system of ductwork. The heating capacity of the heating coils is to raise 3600 c.f.m. from 0F to 70F. Direct expansion refrigerating equipment of 10 tons refrigerating effect with F12 is installed for summer conditioning.

Unusual Methods of Installation

The numerous pipe lengths which went to make up a main were welded together by a welding machine installed at the top of a tower located near one end of the main. As each pipe length was welded to the end of the main, the entire main was pulled through its roll hangers away from the tower, until the entire main was welded together and in place. Openings for branch connections were then burned out, and the branches welded in place. Sections then were burned out of the main at expansion bend locations and the bends were welded in place.

With this arrangement, one pipe length was the maximum necessary to hoist at one time, and it was unnecessary to move the welding equipment until an entire run was completed.

Another innovation was the method of placing the unit heaters. At first, the unit heaters were hoisted into place and hung in the conventional manner, until it became evident that five units per day was the limit of the installation crew at the great ceiling height of this project. Again, mother necessity gave birth to invention.

Accordingly a tower on wheels was built. This tower was provided with a platform which could be raised several feet higher than the top of the tower, by means of a windlass which was operated by two men standing upon the floor. The tower was provided with a hoist also, by means of which a unit heater could be picked up from the floor and quickly placed upon the platform.

The procedure was to roll the tower to a position under a unit heater location. A unit heater was then lifted from the floor and placed upon the platform. Next, the men upon the floor turned the windlass crank, raising the unit heater to its proper elevation. A few minutes sufficed for the tower men to fasten the unit heater to its permanent hangers, then the platform was lowered and the tower rolled to the next unit heater location.

The result was the installation of more heaters per day with the same crew that could install no more than five units per day without the tower—and a contract completed within the time limit without penalty.

Better Air Increases Efficiency in Bank

AIR conditioning of the bank interior has proved very desirable, for it adds to working efficiency and helps in making public relations more than usually good, says E. V. Krick, vice-president and cashier of the American Trust Co., San Francisco, in the Rand McNally Bankers Monthly for November:

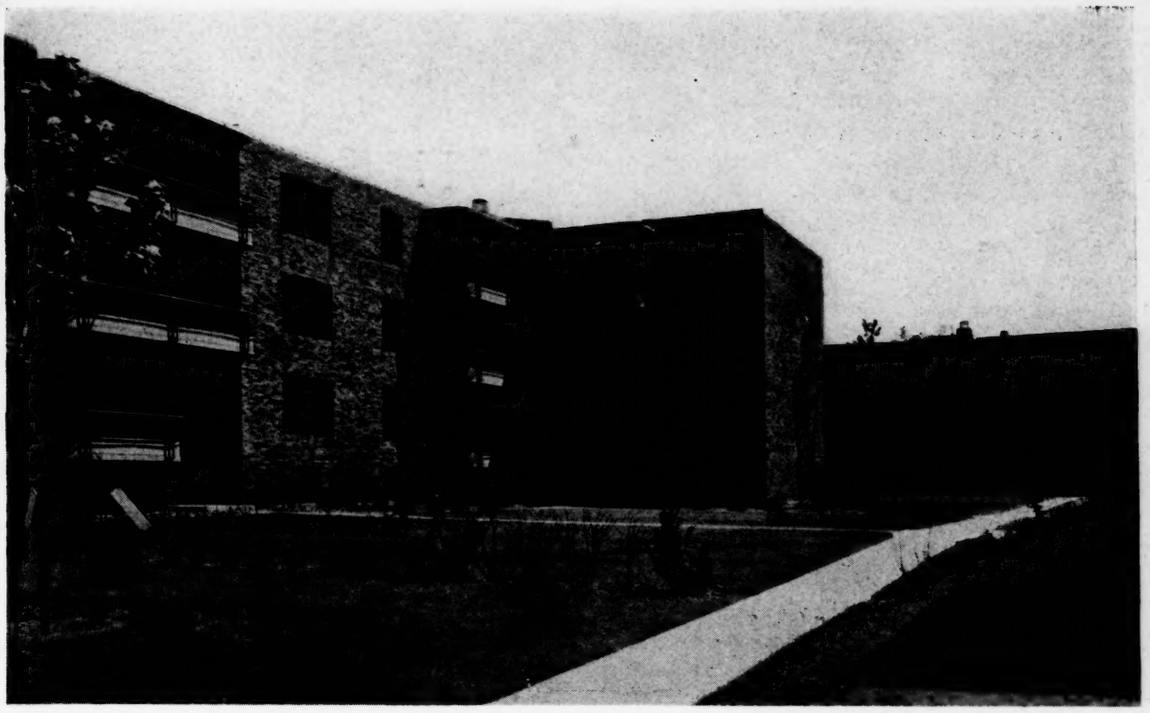
We believe from observation that air conditioning will rapidly grow to become one of the most important factors in the construction or renovation of bank premises.

Central California is not subject to the extreme cold experienced in the East, but a number of our branches are in communities where the summer is characterized by periods of heat and high humidity. We find in these towns a rapidly developing program of installing air conditioning equipment in stores, offices, hotels, restaurants, and certain industrial buildings. From all indications the benefit is immediate and far reaching.

Under the new conditions our staff are able to dispense with such informalities as shedding coats during extreme hot weather and present a proper, businesslike appearance. This means a great deal in the impression received by our customers. Particularly in the discussion of matters involving credit is the atmosphere of the bank a factor that has great bearing on the final understanding.

In rural communities where there is considerable increase of activities owing to deposits of crop checks and other seasonal pick-up during the late summer, without air conditioning it is highly probable that extra employees will be required, or interference made with vacation schedules, neither of which is beneficial to smooth operation.

When the equipment was first installed in each of our branches, some employees constantly requested lower temperatures, hardly realizing the unpleasant after-effects which might result. It was pointed out that persons entering the bank would feel the sudden change. Now it is a routine detail to set the thermostat at the correct relative temperature, and this is maintained through the day. On a very hot day, a relatively high temperature can be maintained without producing discomfort, owing to the fact that the air is filtered and held to the correct humidity.



A courtyard in the Cedar-Central Apartments, Cleveland, Ohio.

Heating Problems of Large Slum Housing Projects

By F. H. VALENTINE†

The heating equipment of a large housing project plays a very important part in the success of the project and must be carefully designed and installed in order to give both the desired service and the most economical operation.

In this article the author discusses the heating system installed in the Cedar-Central Apartments in Cleveland which were erected recently by the PWA. He points out the major features of this installation and then gives his recommendations for future installations based on his experiences and observations gained in connection with supervising the installation of the mechanical work in this project.

OF the three PWA housing projects in Cleveland, the Cedar-Central Apartments is the largest in total number of family apartments. The project site covers 18.5 acres of land, 24% of which is occupied by apartment buildings, stores and garages and approximately 76% by landscaping, walks and recreation areas. The building group consists of 19 three-story apartments, two store blocks, several garage compounds and boiler house. The area is bounded by Cedar Avenue, East 30th Street, by Central Avenue and East 22nd Street.

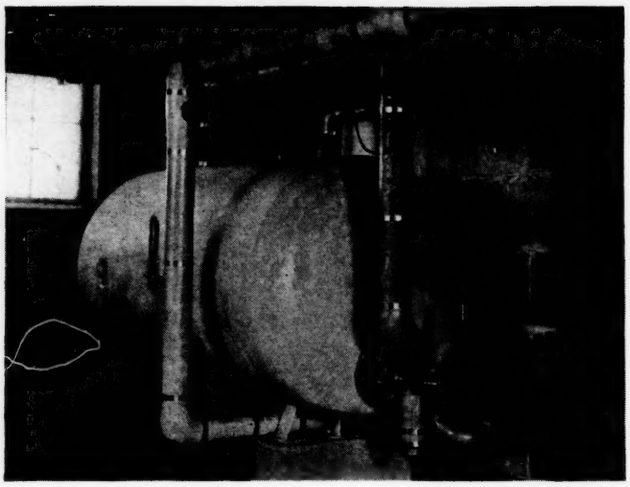
The 19 apartment buildings are subdivided into 8 two-room suites, 352 three-room suites, 226 four-room suites, and 66 five-room suites, making a total of 652 suites of 2306 rooms. There are also two social centers, one at each end of the project, to be used for community activities of the housing tenants. The apartment buildings alone have a total heated cubic contents above basements of 12,279,372 cu. ft.

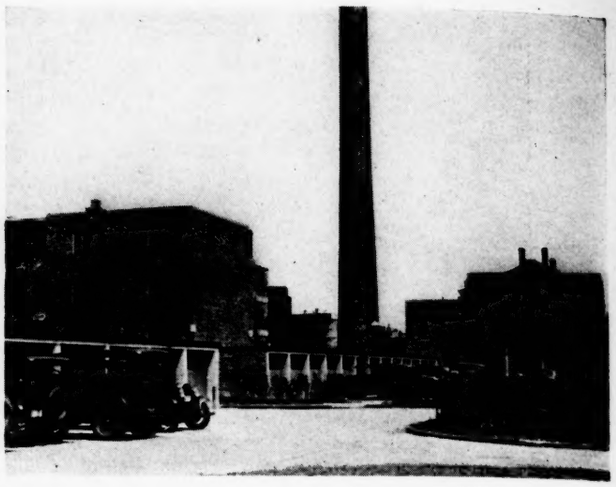
†Consulting Engineer, Cleveland, Ohio.

Building Construction

The apartment buildings on this project are unusually well constructed, the outer walls being built up with a 4-in. brick veneered wall, mortar coated on the back to make watertight and backed up by 8 in. of interlocking hollow block tile, the inner surface of which is coated with a heavy spray coat of water proofing. Plaster about ¾ in. thick is applied directly to this back-up tile. The windows are steel sash casement type, securely set into the back-up tile wall and caulked around the entire perimeter of the window casing; the entrance doors as well as doors to all balconies are adequately weatherstripped by means of interlocking copper strips. The floors are 5 in. thick reinforced concrete with hardwood strip flooring, cemented in mastic to the concrete. The roof is a 5-in. thick reinforced concrete slab, same as the floors, on top of which is cemented a 1½-in. thickness of celotex insulation and on top of the insulation is applied three layers of heavy roofing felt, cemented with hot asphalt to the celotex and then covered with a layer of crushed slag. This type of construction lends itself to economic heating.

All apartment rooms in this project are heated by





(Left) Typical hot water generator hookup in apartment heater rooms. (Right) Boiler house showing chimney and ash storage tank.

means of direct cast iron tube radiators hung on walls to facilitate cleaning underneath them. Branch runouts are above the floor and both runouts and risers are exposed through the room. Bathrooms are heated by means of exposed pipe risers installed behind doors and extending up to third floor and back down to basement. No radiation is provided in basement spaces except in laundry rooms.

Each building laundry is provided with a steam heated drying room, heated by a small unit heater which circulates the air within the drying room and controlled by a thermostatic switch as well as a surface contact thermostatic element fastened to the return of the unit. This is done to prevent the unit fan operating until the unit radiator is fully heated. The stores, of which there are nine, are heated by means of unit heaters suspended near ceilings.

Each building is provided with a domestic hot water generator which is heated with steam at 5 lb. pressure supplied by the yard distribution system. The returns from the coils in the generators are trapped to flash tanks and then to the general building return. Each generator is provided with vacuum breaker and automatic air vent.

The total combined equivalent direct radiation load, not including underground steam mains or building basement mains, is equal to 111,186 sq. ft., divided as follows: direct column radiators, 61,205 sq. ft.; bathroom heat risers, 4014 sq. ft.; unit heaters, 6587 sq. ft.; hot water generators, 30,200 sq. ft.; and exposed uncovered steam risers and radiator supply runouts above basements, 9180 sq. ft.

Steam Generation

Steam for this heating load is generated at 80 lb. pressure by two 250-hp. three drum vertical bent tube boilers set single, and fired by overfeed spreader type stokers. These stokers are capable of burning run of mine slack coal and producing 175% rating on boilers. No reserve boiler is provided nor is space provided for installing a third boiler so that the two boilers will by necessity have to care for the maximum heating load. An electric combustion control system regulates stoker feed, forced draft fan speed, and forced draft fan discharge damper position from steam pressure variation. The uptake damper position is controlled to maintain a fixed furnace draft. Each boiler is equipped with feed water regulator control, soot blowers, draft gages, steam flow meter, and CO_2 recorder.

Coal is delivered to the stoker hoppers by a hand-operated coal hoist and monorail system equipped with a tilting bucket. The coal can be weighed by a weighing section in the monorail track.

Ashes are removed by a vacuum type steam jet conveyor system to an ash storage tank outside of boiler house from which the ashes will be discharged into trucks. Fly ash is recovered from the flue gases in the third pass chamber and also by means of a cinder trap installed in the breeching between the boilers and chimney. The cinder trap is connected to the ash conveyor system so as to provide easy removal of fly ash collected in the trap.

A radial brick chimney 6 ft. 6 in. diameter by 120 ft. high will carry the gases of combustion well above the project buildings.

Steam Distribution

Steam for the general heating system is reduced from 80 lb. header pressure to 30 lb. yard distribution system pressure through a primary reducing valve arrangement of the outside pilot controlled type with the intermediate pressure in the pilot piping. The purpose of this is to insure a steady pressure on the diaphragm of the main pressure reducing valve, regardless of the pressure fluctuation in the high pressure steam supply header.

In each building is located a heater room into which the steam service from the underground distribution lines enters. Here the steam is reduced through two secondary pressure reducing valve stations, one reducing from 30 to 2 lb. for the building heating system and one reducing from 30 to 5 lb. for the hot water generator and laundry drying room unit heater services. In the secondary reducing valve arrangement, steam from the 30-lb. line flows through a pilot valve, normally held open by a spring, into the steam chamber of the main reducing valve. A spring in this main reducing valve normally holds the valve closed. As the steam

pressure builds up on the diaphragm of the main reducing valve it causes the valve to open and steam to flow through into the low pressure piping system. When the pressure in the low side piping reaches a predetermined point, it acts on the diaphragm of the pilot valve and causes this valve to close and shut off steam. As the steam pressure on the diaphragm of the main reducing valve is reduced the spring in the valve tends to close, shutting off the flow of steam from the 30-lb. line to the low pressure system main.

The underground steam distribution system is installed in vitrified tile conduit thoroughly waterproofed on the outer surface joints. In the installation of this underground system, after the trenches had been dug to proper grade, a concrete base 4 in. thick and full width of conduit tile was poured on the trench bottom. This concrete base was provided with a drain channel extending full length of base run to keep the pipe space dry. Drainage is made through manholes to the sewer.

The pipe lines in the conduit are supported from this concrete base on special adjustable supports. Expansion is provided for by means of expansion pipe loops, made up of pipe and welded elbows. The steam lines within the conduit envelop were insulated with 1½ in. thickness of asbestos laminated sponge felt covering with an integral water proof jacket.

The total amount of underground steam piping installed was 3860 ft., total of return mains 2820 ft., and total of conduit and base 3320 ft.

The heating system within the apartment buildings and stores is of the two-pipe vacuum type with thermostatic traps and modulating valves on all radiators, combination float and thermostatic traps on all unit heaters, hot water generators and main drips.

Steam Returns

There are five vacuum pump stations located in heater rooms at strategic points in the project each taking care of a number of nearby buildings. Returns from the group buildings served by these respective pump stations are brought back in a common return and connected to an electric driven vacuum pump. Each pump is controlled by a vacuum regulator as well as float control switches. The vacuum pumps discharge the condensate through underground pump discharge lines installed in same conduit as steam mains to the boiler house. Here the condensate is discharged into a deaerating feed water heater and storage tank with auxiliary cold water feed for makeup. Each vacuum pump station is bypassed to the sewer for gravity discharge in event of pumps being out of order.

Water at about 160F from the feed water heater tank, is delivered to the boiler by a duplex boiler feed pump controlled by an excess pressure regulator. The condensate returned is heated by the exhaust from boiler feed pump, supplemented by steam from boiler header through a pressure reducing valve station.

In this group of buildings there are installed 111,964 ft. of steam and return mains, 25,650 ft. of pipe covering, 2460 direct radiators, 28 hot water generators, and 40 unit heaters.

Mechanical design was made by Jones, Cary and Millar, engineers; installation of the heating work was done by the W. G. Cornell Co., New York City; architectural features were handled by Walter R. McCornack, architect.

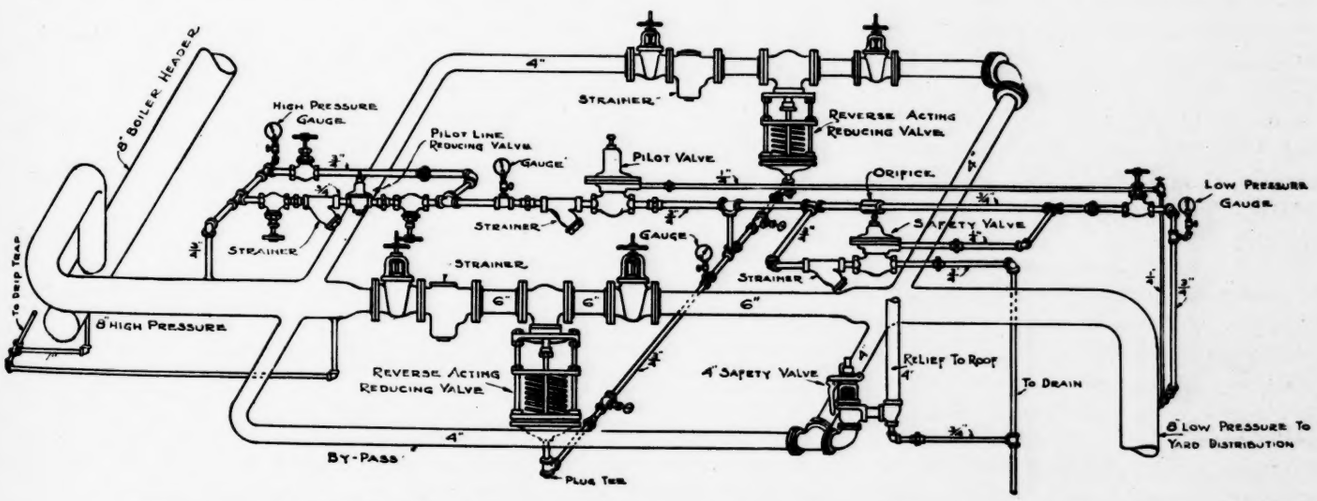
Recommendations for Future Housing

The heating equipment of a large housing project plays a very important part in its operation and success and must be carefully worked out to give the service desired in the most efficient way, as lack of proper heating is a liability to the health and comfort of the occupants.

In considering the problem of design for any heating plant in connection with any large housing project, whether for steam or hot water distribution, it is obvious that simplicity is most desirable and reliability is essential. As a guide in comparison to the Cedar-Central Apartment's plant described herewith or other similar installed plants to what future design in heating problems may include to meet definite objectives based on fundamental requirements and economic advantages, I will present the following outline of the major problems that should be carefully studied.

Boiler Plant

The best location of the boilers and boiler room equipment, the heart of any heating plant, is a problem



Diagrammatic sketch of primary reducing valve arrangement used to reduce steam pressure from 80 to 30 lb. for yard distribution.

peculiar to each project. However, it should be located as near as possible to the load it is to serve. The ideal location would be in the center of the total heating demand for then the shortening of distributing lines becomes an installation economy and as there are line losses in all of them no matter how carefully they are insulated, there are considerable operating economies in shortening the distribution system from the source of supply to the point of usage.

Boilers

Boilers for any housing project should be designed and selected for the maximum load demand at reasonable overload ratings to take care of momentary peak demands and a reserve boiler unit should always be provided for taking care of breakdowns or cleaning service to boilers under fire. This insurance against uninterrupted service to housing tenants in cold weather is warranted by the additional expenditure. Boilers should be provided with sufficiently high settings assuring ample combustion space for complete and effective combustion of the fuel feed or waste of fuel with smoke violations will result.

Suitable protective platforms and ladders should be provided for access to all important operating parts of the boilers and settings. These are necessary for safety of operators as well as reducing labor in maintenance operations.

Stokers

Underfeed stokers operating at low burning rate per square foot of grate area are recommended for straight heating loads as their operation is more flexible with load demands, produce less blow over of unburned coal in forcing periods and in general will show less maintenance costs for equal load performance than other types of stokers. Simple compensating control of stoker operation synchronized with combustion control should be used.

Steam Pressure Reduction

Steam pressure reduction from boiler operating pressure to yard distribution pressure should be kept low consistent with safety and line pressure drop, the reduction should be made by single seated regulating valves, preferably through double reduction, the regulator being of proper size determined by pressure differential together with demand load and steam velocity so as to reduce wire drawing of the valve seats and valve oscillations. Would not recommend the outside pilot control arrangement as the regulation is most difficult to control effectively, particularly on low steam demands and, further, any valve arrangement depending on orifice flow control is troublesome. The initial costs of the former method of control is considerably less than the latter and the results obtained in general heating do not warrant the additional investment and maintenance costs. This same reasoning applies to secondary valve regulation within the respective buildings.

Fuel Supply

Some form of electric hoisting and traveling bucket should be provided to minimize labor in handling of the coal from the storage room to the stoker, thus allowing the operators more time and giving them more incentive to take care of other boiler room duties.

Ash Removal

A suitable and adequate ash removal system not requiring an excessive steam consumption for its operation should be provided to effectively remove all ash, clinker and fly ash with minimum of labor and abrasive action to equipment. This will result in keeping a clean condition in the boiler room as any unnecessary accumulation of ash and carbon dust on boiler room equipment results in deterioration of plant at an early date. The ash storage tank should be provided with suitable means of heating to prevent freezing of saturated ash in tank in cold periods, entailing extra labor in moving ash to trucks.

Underground Distribution System

Line distribution system should be so designed that in event of break-down on any part of the system, it will not be necessary to shut off steam service to the entire project. This can be accomplished by a loop system of distribution properly valved.

Apartment Heating

Each apartment building or block should be heated by proper sized radiators in occupied rooms; the steam demand controlled by a simple control automatically varying the steam supply with outdoor temperature changes to reduce overheating, opening of windows, and consequent waste of fuel.

Vacuum systems are recommended for large developments and when properly installed will give satisfactory heating results with minimum of fuel consumption and maintenance. In the building piping system, valved branch control to various sides of the building are recommended so that at no time will it be necessary to shut steam service off the entire building to make repairs to traps, etc., on any one branch. Where centralized vacuum pumps are installed in unit groups of buildings, the return system of each building should be separated from adjoining building to permit of effective and positive circulation and balancing as well as permitting of quick determination of leaks in individual building systems.

Where flash tanks are required on building high pressure service line drips, the relief or vent should be piped to the heating system rather than to the atmosphere as this loss of heat vapor to the atmosphere is an economic loss reflected in the fuel consumption. This discharged heat vapor is usable in heating effects.

Bathrooms should be heated by means of controlled convector radiators set behind metal casings in walls rather than by exposed heat risers for safety against body burns and damage to room trim.

Hot water generator returns should be connected with the vacuum system to produce maximum heat exchange in the generator per pound of steam used rather than by open atmospheric release which is sluggish and requires additional steam demand.

All drip traps on building line drainage points should be provided with dirt strainers to check inflow of rust, scale, and other pipe sediment into the traps, thus causing the traps to become inoperative.

Bowling Alley Modernized with Unit Heaters

BY WILLIAM A. HEARTT†

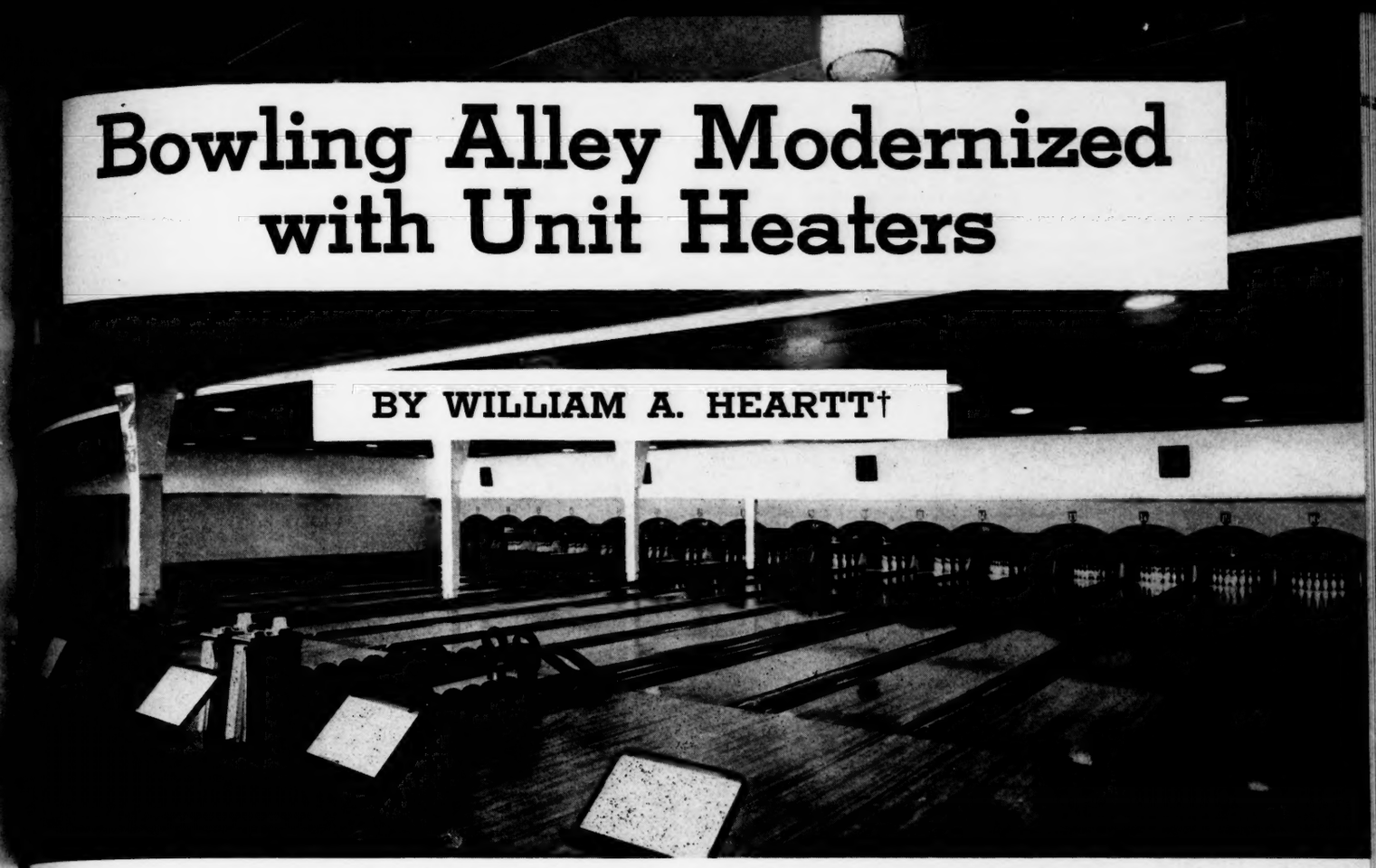


Fig. 1. Interior of 16-alley bowling room, which is served by four ceiling-type unit heaters.

THE demand for air conditioning finds the proprietor of an existing bowling alley under the necessity of exercising the utmost economy in obtaining an installation. The intake from play cannot be increased by adding to the established rates per game. Changes in equipment must be installed between winter seasons. There is no information available upon which to base a claim that the play season can be extended, and open bowling continued during the summer months, in a cooled and ventilated alley. In the case of the Center Bowling Alley at 3087 East Grand Boulevard, Detroit, we were compelled to make a first step toward air conditioning because of the necessity of making repairs and improvements of the heating system, as it existed in the summer of 1936.

In presenting these facts pertaining to the installation finally made in the Alley, the desire of the writer is to point out a way to approach ideal heating, ventilating and air conditioning in bowling alleys, by gradual and economical changes.

The building is 100 ft. wide by 95 ft. deep with an 11-ft. 10-in. ceiling on the first floor, where are located 16 alleys. A room across the front of the building on the second floor, 18 ft. by 100 ft. with a 10-ft. ceiling is used as a billiard parlor.

Heat is furnished by a cast iron, sectional, low pressure boiler. In the existing plant cast iron floor and ceiling radiators were suspended over the spectators' and players' benches, at the north end of the room. In the illustrated plant (Fig. 2) these heating surfaces are replaced by four unit heaters, fitted with three-speed motors, and installed within 18 ft. of the south wall, as shown clearly in both Figs. 1 and 2. A fifth unit heater is located in the billiard parlor on the second floor. The only additional new equipment installed was an automatic stoker having 150 lb. capacity per hour.

The results expected from thermostatic control of the stoker, in more uniform temperature and economical use of fuel, were fully realized. A summary of coal bills comparing the cost for the 1935-36 and the 1936-37 seasons are shown in Table 1. It will be noted that these figures indicate a difference in fuel cost of $84.56, or 21.7%. This result should have been considerably better if improvements in ventilation of the boiler room, as recommended, had been previously made.

The purpose in arranging two depending partitions as shown in Fig. 2 is to divide the return flow of air so as to direct the lowest stratum along the floor to the rear wall past the pin-boys to insure cooler working conditions, and particularly to prevent drafts in the winter season.

The purpose of the three-speed motors on the unit heaters is to afford a simple means of governing the flow of air winter and summer. The second speed was found most satisfactory during the coldest days.

The result of controlled flow during the spring and summer months has been to provide such comfort, even on the hottest days, as to sustain the play through the summer on a profitable basis. The highest speed

TABLE 1

Season	Lb.	Coal	Fired	Cost
1935-36..	138,120	Kentucky Elkhorn	Hand	$393.87
1936-37..	96,400	Olga Pea	Stoked	309.31

†Industrial Engineer, Detroit, Mich.

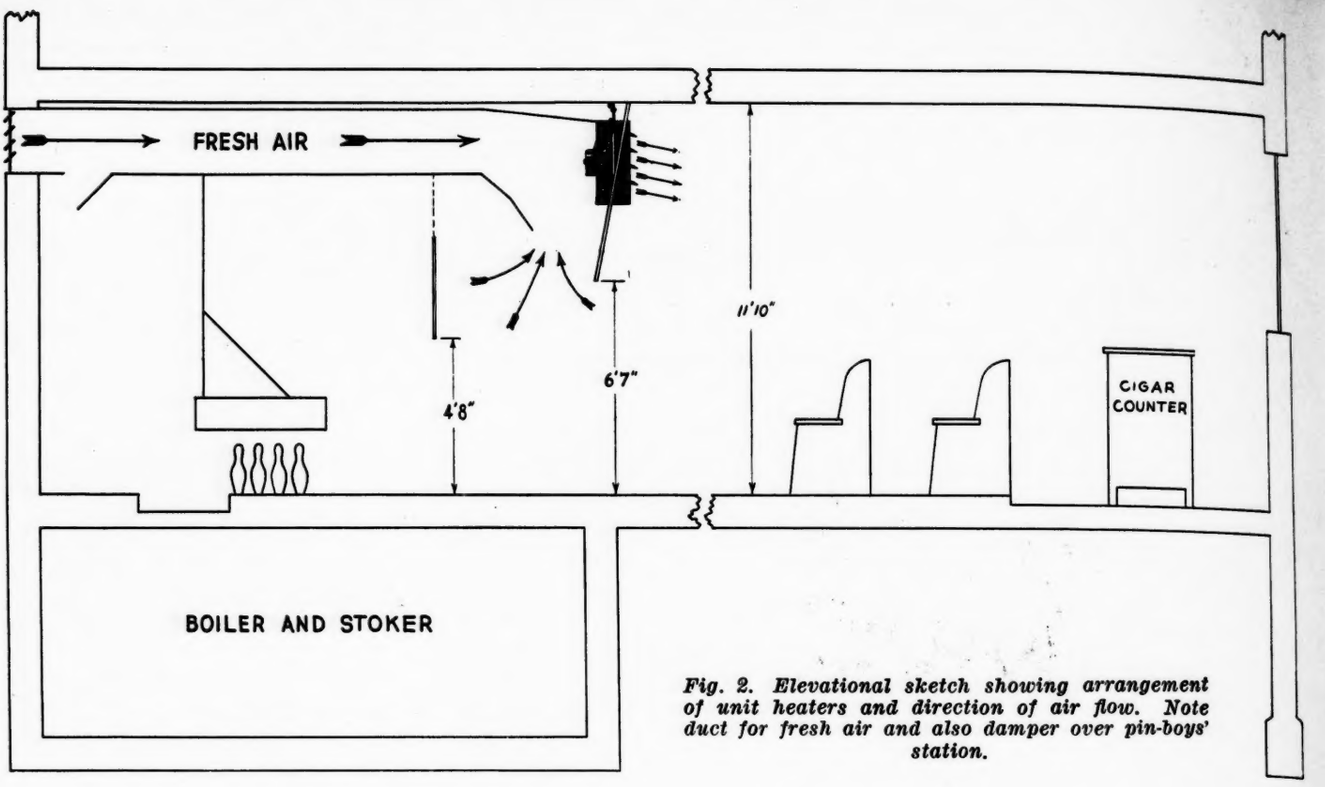


Fig. 2. Elevational sketch showing arrangement of unit heaters and direction of air flow. Note duct for fresh air and also damper over pin-boys' station.

has proved sufficient to blow a breeze in the faces of players and spectators. The slow flow of the heated air in the winter serves to bank the heat over the spectators and players where as it gradually cools in its downward flow it draws off smoke and body odors toward the rear of the alleys.

Anticipating future demand for refinements, sufficient space has been left back of the unit heaters to install screens, filters, washers and cooling equipment, in line with a window which may be cut in the rear wall as illustrated. Thus far only infiltrated air has been used for refreshing the room. It has been felt that there is danger of overdoing the cooling because of the possibility of chilling the players.

The experience of the past season would indicate that the expense of additional equipment, and its operation, would not be productive of sufficient additional play to warrant the investment necessary to take further steps at this time.

Improvements were made by the tenant, Charles J. Roberts, with the approval of the Detroit Trust Co., building owner. Equipment list is as follows: boiler by U. S. Radiator; unit heaters by McCord Radiator & Mfg. Co.; automatic stoker by Combustioneer, and installed by Cunningham Stoker Service Co.; coal by Better Fuel and Supply Co., Detroit.

Forced Draft Heating Towers

THE air in machine rooms of paper mills contains considerable heat, released by convection from the drier rolls and by evaporation of hot water from the paper. Furthermore, although not fully saturated, it contains a heavy charge of moisture. This air is circulated constantly in order to accelerate the evaporation of the water at a reasonably low temperature. According to "Heat Engineering," the hot, moisture-laden air at temperatures of 150 to 160F, which is continuously discharged from machine rooms to make way for cool, fresh air, can be made to supply hot water for the mill. The low first cost of such a system and its high return on investment may well bring about its general adoption.

In this system, the hot air from the machine room is blown by the regular ventilating machinery (or by an auxiliary fan) up through a redwood, forced draft tower. Here a finely divided shower of water absorbs the heat from the air, at the same time condensing much of the water vapor and returning it to the mill. The water may be heated to within a few degrees of the wet bulb temperature of the air leaving the drying room.

A forced draft heating tower was installed in a prominent paper mill where the machine room was exhausting 50,000 to 70,000 c.f.m. of air, containing a high percentage of moisture at a dry bulb temperature of about 150F, wet bulb 118F. During an exhaustive operating test of the tower, 348 g.p.m. of water were heated from an average inlet temperature of 66F to an average outlet temperature of 110F. In the heating of this water, there was represented a heat recovery of 7,656,000 B.t.u. per hr. Assuming a cost of 30 cents per million B.t.u. the hourly recovery amounted to about $2.30. On the basis of an annual operation of 7000 hr., the actual saving would be about $16,000 per year. First cost of the installation was about one-third of this annual saving.

Number of Days During a Normal Heating Season

Previous maps and tables have shown the dates of the beginning and end of the heating season in a normal year. With these dates established, the length of the heating season in days can be determined by a simple count of the number of elapsed days between the dates. The accompanying map shows this length of season in a normal year; the table gives these data more specifically for the largest cities.

Definition of Season Length

The number of days in a given heating season for a specific city would be, by the definition of heating season previously set up, the number of days from August 1 to July 31 when the mean daily temperature was below 65F. Such a count shows that in the greatest part of the country the heating season would not be continuous. As fall comes on, there are isolated days when the mean temperature falls to 65F or slightly lower with subsequent days above 65F. As fall continues the number of such isolated days of 65F or lower increases until all days are below 65F continuously. The opposite occurs in the spring.

In exceptional years the first day below 65F in the fall occurs very early; similarly the last of such days in the spring could be quite late relative to normal occurrence. However, as pointed out before, the beginning and ending dates average about as shown.

Normal Versus Actual Count

Since this is true, the number of days in a normal season determined by elapsed days between these dates agrees closely with actual count of days below 65F. There is some evidence to show that even though there may be occasional warm (66F or higher) days after the normal ending date, nevertheless the number of days in a given season agrees closely with the normal number.

For example, actual count of the number of days in five heating seasons in Columbus, Ohio, shows:

Heating Season	Number of Days in Heating Season
1932-33	242
1933-34	232
1934-35	254
1935-36	248
1936-37	248
Average	245

The number of days between the beginning and ending date as shown in the table is 245.

Text continues following Map and Table

NUMBER OF DAYS
IN A NORMAL HEATING SEASON

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NUMBER OF DAYS IN HEATING SEASON IN A NORMAL YEAR

City	Days in Season
Albany, New York	267
Albuquerque, New Mexico	239
Atlanta, Georgia	201
Baltimore, Maryland	232
Birmingham, Alabama	188
Boise, Idaho	280
Boston, Massachusetts	273
Buffalo, New York	283
Burlington, Vermont	285
Butte, Montana	365
Charleston, South Carolina	175
Charlotte, North Carolina	206
Cheyenne, Wyoming	315
Chicago, Illinois	257
Cincinnati, Ohio	240
Cleveland, Ohio	267
Columbia, South Carolina	189
Columbus, Ohio	245
Concord, New Hampshire	302
Dallas, Texas	181
Denver, Colorado	274
Des Moines, Iowa	251
Detroit, Michigan	268
Duluth, Minnesota	365
El Paso, Texas	191
Erie, Pennsylvania	272
Eugene, Oregon	330
Evansville, Indiana	220
Fitchburg, Massachusetts	284
Flagstaff, Arizona	341
Fort Smith, Arkansas	199
Fort Wayne, Indiana	256
Frederick, Maryland	243
Grand Forks, North Dakota	313
Grand Rapids, Michigan	269
Great Falls, Montana	312
Greensboro, North Carolina	216
Hartford, Connecticut	272
Houston, Texas	142
Huntington, West Virginia	235
Indianapolis, Indiana	242
Jacksonville, Florida	143
Kansas City, Missouri	231
Knoxville, Tennessee	216
Lexington, Kentucky	232
Lincoln, Nebraska	247
Little Rock, Arkansas	196
Los Angeles, California	230
Louisville, Kentucky	220
Madison, Wisconsin	273

City	Days in Season
Memphis, Tennessee	195
Meridian, Mississippi	188
Milwaukee, Wisconsin	284
Minneapolis, Minnesota	275
Minot, North Dakota	314
Mobile, Alabama	165
Newark, New Jersey	249
New Orleans, Louisiana	144
New York, New York	250
Norfolk, Virginia	214
Oklahoma City, Oklahoma	210
Omaha, Nebraska	244
Paterson, New Jersey	252
Pensacola, Florida	159
Peoria, Illinois	256
Philadelphia, Pennsylvania	238
Phoenix, Arizona	158
Pittsburgh, Pennsylvania	245
Portland, Maine	304
Portland, Oregon	304
Providence, Rhode Island	280
Pueblo, Colorado	262
Reading, Pennsylvania	251
Reno, Nevada	301
Richmond, Virginia	220
Rochester, New York	277
St. Louis, Missouri	221
Salt Lake City, Utah	267
San Antonio, Texas	144
San Diego, California	262
San Francisco, California	365
Savannah, Georgia	167
Scranton, Pennsylvania	266
Seattle, Washington	365
Shreveport, Louisiana	174
Sioux City, Iowa	260
Sioux Falls, South Dakota	275
South Bend, Indiana	256
Spokane, Washington	365
Springfield, Illinois	239
Syracuse, New York	273
Topeka, Kansas	234
Trenton, New Jersey	244
Tulsa, Oklahoma	212
Vicksburg, Mississippi	174
Washington, District of Columbia	236
Wheeling, West Virginia	276
Wichita, Kansas	226
Wilmington, Delaware	239
Yuma, Arizona	133

Year Round Region

Certain portions of the map are labeled "Year Round," indicating a 365-day heating season. This should not be taken too literally; as a matter of fact, the season in these regions **approaches** 365 days but rarely attains that figure. For example, in Duluth the normal daily mean temperature never rises above 65F. Consequently, heat may be necessary any day of the year; or, since the normal is an average, heat may not be necessary. Actual count of days not requiring heat (according to the conception previously explained) in Duluth shows the following length of heating season in that city for five years as follows:

Heating Season	Number of Days in Heating Season
1932-33	313
1933-34	326
1934-35	326
1935-36	324
1936-37	315
Average	321

Thus, although Duluth has a heating season approaching Year Round it never actually reaches 365 days in length.

A similar count for San Francisco shows:

Heating Season	Number of Days in Heating Season
1933-34	331
1934-35	332
1935-36	338

Accuracy of Map

The data indicate that the map and table are substantially accurate except in the Year Round regions and in the Rocky Mountain area where, due to the topography, the map cannot show in detail the wide variation in climate. Since all of these regions are not too densely populated the departure from accuracy in those places does not detract seriously from the usefulness of the map.

Swiss District Heating System Uses High Temperature Water

High temperature hot water with a thermal storage feature is being used in a number of recent district heating installations in Switzerland. Here one at the Cantonal Hospital at Lausanne is described

RECENTLY the Cantonal Hospital at Lausanne, Switzerland, found it necessary to consider the installation of a new heating plant, the old equipment being unable to meet present requirements. At first it was planned to replace the separate installations by one central plant to be managed by the hospital itself. However, the fact that the Pierre de Plan thermal power station is located in the direct neighborhood of the hospital led to negotiations between the municipal and cantonal authorities, who own the power station and the hospital, respectively, and an arrangement was made whereby all the heat required for the hospital buildings will in future be supplied by the electricity works. In addition to the hospital heating installations, a swimming bath and a laundry will also be connected to the electricity works, the plant in which has been so arranged that heat can also be supplied to other consumers.

High Temperature Water Chosen

The choice of heating medium was the subject of special investigation, since the method of transmitting the heat has a great influence on the overall efficiency. In recent times, heating by means of high temperature water is being more and more adopted. With this method of heat transmission, water at a temperature over 212F is adopted to transmit the heat. An important advantage obtained by adopting this method of transmission is that an efficient high temperature water reserve can be provided without any complicated apparatus. In the case of high temperature water a simple method of providing this reserve is obtained by fitting a high temperature water tank between the flow and return mains.

One of the most important conditions for the Pierre de Plan power station was to make use, as far as possible, of surplus hydro-electric energy. This is only feasible if a sufficient reserve can be made available, as is the case when high temperature water is adopted for heat transmission.

The buildings connected to the district heating mains are all in a hilly district. The presence of various viaducts, and also the necessity of avoiding existing buildings, made it necessary to choose a rather complicated route for the district heating mains. For this reason, too, water was unquestionably a more favorable medium than steam.

The cost of energy required for operating the pumps for circulating the high temperature water hardly affected the decision, since the Pierre de Plan power station is operated by the municipal electricity works of Lausanne.

The Pierre de Plan power station has two diesel engines, each of 2000 kw., and two condensing steam turbine sets, of 1000 and 2000 kw. The total installed capacity of the plant amounts therefore to about 7000 kw.

Coke Breeze is Used

The existing steam boiler plant has been extended by installing a new high pressure upright watertube boiler, specially designed for burning coke breeze from the Lausanne gasworks. Coke breeze from other gasworks can however also be burnt, if it does not differ much in quality from the Lausanne coke.

In this way it is possible to utilize all the coke breeze produced in the Lausanne gasworks. But since the quantity of such fuel available in the course of a year is not sufficient for covering the total demand for heat, the stoker of the high pressure boiler is arranged so that it can also burn coal, or coal and coke breeze mixed in any desired proportions.

The choice of a high pressure steam boiler will make it possible to utilize the additional heat drop in a primary steam turbine set. This turbine set has, however, not yet been installed, since the Lausanne electricity works has at present sufficient electric energy available from other sources. But if a change should occur in the course of time, an inexpensive source of peak load and standby energy can easily be provided.

For utilizing the exhaust heat from the turbine sets, two steam to high temperature water ex-

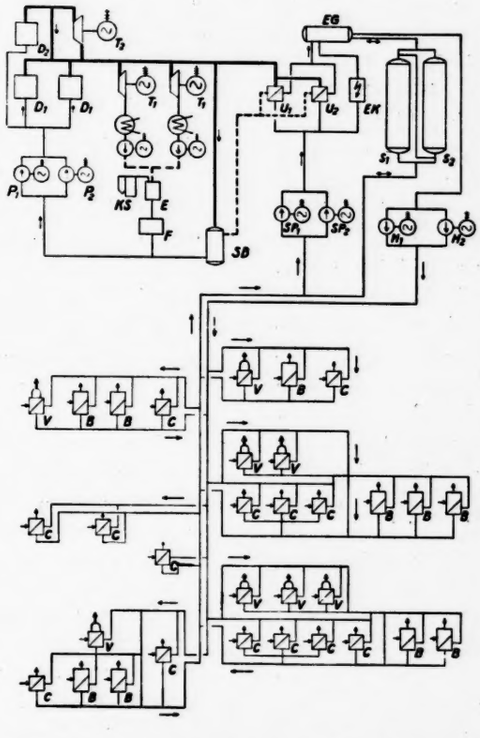


Fig. 1. Schematic diagram of the equipment in the district heating plant and substations, showing how stations and district plant are interconnected.

changers are provided. The heat is transmitted through heat exchange surfaces, so that the water circuit and the steam circuit are kept quite separate.

The pumping plant comprises the boiler feed pumps, and also the high temperature water circulating pumps for the internal and external hot water circuits. They are accessibly arranged in the room below the electrode boiler and the steam to hot water transformers.

The electric boiler plant can be fully and effectively utilized only when a sufficient reserve is provided. Consequently, two vertical high temperature water tanks have been installed in a room beside the coal bunkers.

A new fuel conveying and bunkering plant has been designed independently from the existing plant, which would have in no way complied with the new requirements. When planning this new layout, great importance was attached to cleanliness in service.

How the System Works

Fig. 1 shows diagrammatically how the apparatus in the central station and substations is interconnected. D1 represents the steam boiler plant existing before the extension. The steam raised in it at 176 lb. gage is led in two condensing turbo sets T1. By means of the new high pressure water tube boiler D2 an additional heat drop has been provided, which will later be utilized in a primary turbo set T2. At present the steam raised at 661 lb. gage in this boiler is passed into the 176 lb. system through a reducing valve, and then used either for driving the turbo sets T1, or for producing high temperature hot water in the transformers U1 and U2.

The high temperature water tanks S1 and S2 work in conjunction with the other equipment as follows: The high temperature water circulating pumps H1 and H2, fitted in the flow piping, withdraw water from the expansion tank EG and circulate it through the heating system. When the pumps SP1 and SP2 for the tanks are stationary, the return water enters into the lower part of the high temperature water tanks. If the pumps for the tanks are delivering exactly as much water as the circulating pumps, all the high temperature water then circulates through the transformers U1 and U2 or the electrode boiler EK, through the expansion tank EG, from where it is again taken by the high temperature water circulating pumps H1 and H2 and passed through the heating system and back again to the pumps for the tanks. In that case the reserve in the high temperature water tanks remains unaltered. On the other hand, if the pumps SP1 and SP2 are delivering more water than the pumps H1 and H2, water is withdrawn from the lower part of the tanks and passed through the transformers, U1 and U2, or the electrode boiler EK, through the expansion tank and back again into the tanks. It is consequently possible to adjust the rate of charging or discharging of the high temperature water tanks as desired, by regulating the quantity of water flowing through the pumps for these tanks.

From the power station the high temperature water passes through a double pipe system to the individual substations. These contain high temperature water steam transformers V, service-water transformers B, and central heating transformers C. From the diagram it can be seen that in some of the substations the transformers are fitted in series. This arrangement in series of the transformers makes certain demands on the regulation. The regulating system allows the operation of the transformers to be suited exactly to all fluctuations in load, while at the same time the quantity of hot water in circulation is kept as low as possible.

To be able to cover heat requirements in summer from surplus hydraulic energy, an electrode high temperature water boiler was installed; it is designed to work on 6000 V supply and take a maximum load of 5000 kw., corresponding to 17 million B.t.u. per hr. The boiler is fitted with automatic regulation, which keeps the temperature of the high temperature water at the outlet constant. The load regulator can be set as desired between the limits of 800 and 5000 kw. and prevents the load taken by the boiler exceeding a definite figure, selected from service requirements.

When the coal-fired boilers are working, high temperature water can be produced in heat transformers, which are heated with steam at a pressure of 176 lb. The maximum capacity of each transformer is 19,840,000 B.t.u. per hr. The transformers are fitted with regulators which keep the flow temperature of the high temperature water constant.

The transformers, and also the electrode boilers, are automatically regulated in such a way that the temperature of the water is kept constant at the outlet; but if the limiting regulator on the electrode boiler comes into operation, it may happen that the water is not sufficiently hot. In order to prevent this, a further regulator is provided which prevents colder water passing into the expansion vessel and the flow piping should the temperature of the water fall below normal.

Two high temperature water tanks, each of 2300 cu. ft. capacity, are provided which work on the displacement principle. With a temperature difference of 175F between the flow and return, it is possible to have a reserve of high temperature water with a heat capacity of about 39,600,000 B.t.u.

Distribution System

Only one row of double pipes issues from the power station. The reason which led to the adoption of this system has already been mentioned. The district heating mains are, wherever it was not possible to place them in basements, arranged almost entirely in ducts through which there is no passageway. Under the main road Berne-Lausanne is it possible for a man to creep through the duct. The rather complicated run of the piping generally allows for natural contraction and expansion, so that expansion bends had to be fitted only in a few straight runs. Particular attention was paid to the question of suspension, since the pipes are no longer accessible once they have been laid, and it was therefore necessary to ensure that the method of supporting was absolutely reliable. At intervals the pipe is suspended by an articulated member to a short longitudinal bar which itself rests on two rollers, eliminating sliding friction and ensuring a minimum of wear.

The high temperature water is circulated by means of centrifugal pumps, specially designed for this service, installed in the pump room of the power station.

At the outlet from the power station the internal diameter of the district heating main is 150 mm. (6 in.).

All district heating pipes are covered with a special insulating medium. Supporting rings are fixed at intervals of about one and one-half feet and covered with wire netting. The intervening space between the wire netting and the pipe is filled with slag wool, mixed with a small quantity of magnesia. The actual strength of this insulation is provided by a covering of hard cardboard laid round the wire netting, or by a sheet metal covering at places where the pipe is more exposed. All district heating pipes laid in ducts to which no accessible passage is provided are covered with sheet metal, while those in accessible places are insulated with hard cardboard. The thickness of the insulation has been designed to give the maximum possible economy. As a result of calculations on the probable heat losses, insulation 80 mm. (3⅛ in.) thick was chosen for the 150-mm. flow pipes, and insulation 50 mm. (2 in.) thick for the return pipe.

Drying of Lumber

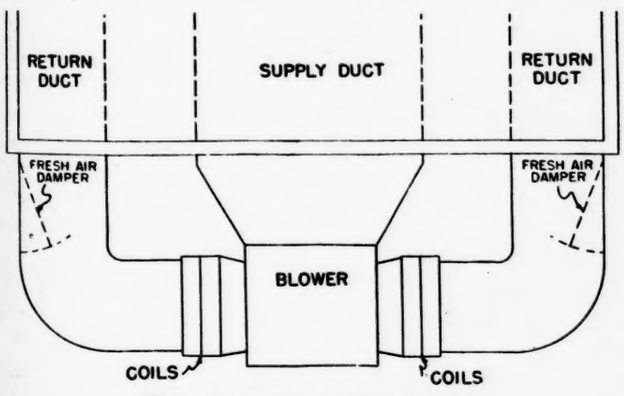
EFFICIENT and proper curing of lumber has long been one of the major problems of the lumber industry. Thorough drying of lumber is necessary to prevent shrinkage and warping, and checking and peeling of paint at a later date. An excellent discussion of this subject appeared in a recent issue of the Trane Weather Magic. Abstracts follow.

The basic principle of all dry kilns is the same since all must take into consideration the factors of humidity, temperature, distribution of air, circulation of air, direction of air flow and the proportion of fresh air to recirculated air.

Speed of drying is primarily dependent upon the rate of removal of moisture from the lumber. Care must be taken for if extreme temperatures are maintained moisture is evaporated from the surface too rapidly and case hardening and surface checks result. Efficient drying requires that proper temperatures and humidities be maintained so that the rate of transfusion of moisture from the interior of the wood to the surface is at exactly the same rate as removal of moisture from the surface. The temperature to be maintained therefore, depends rigidly upon the type of lumber being dried, size of the lumber, moisture content and the stage of drying process.

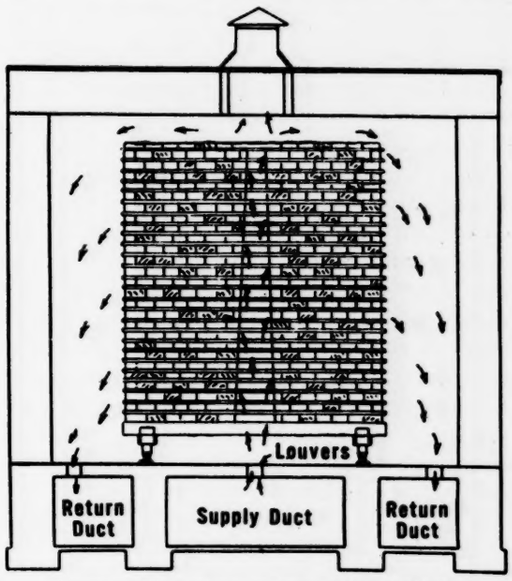
Humidity also plays an important part in lumber drying. Past experience has proved that by introduction of increased humidity higher temperatures may be maintained, thereby speeding up production. The higher temperatures thus permitted speed up internal drying time while the increased humidity retards surface drying and prevents case hardening too.

Proper circulation and distribution are also most important. To prevent uneven drying it is necessary that there be a continuous flow of heated air to carry away evaporated moisture. The volume of air circulated must be large enough so that the temperature drop between inlet and outlet is kept at a minimum.



Plan of an external fan dry kiln.

For the successfully operated kiln, arrangements must be made for the expelling of moisture-laden air and the introduction of the proper proportion of fresh air. This must be done to maintain air at proper humidity. A maximum of recirculated air is usually used as it means great savings in heating costs.



Cross-section of an external fan dry kiln.

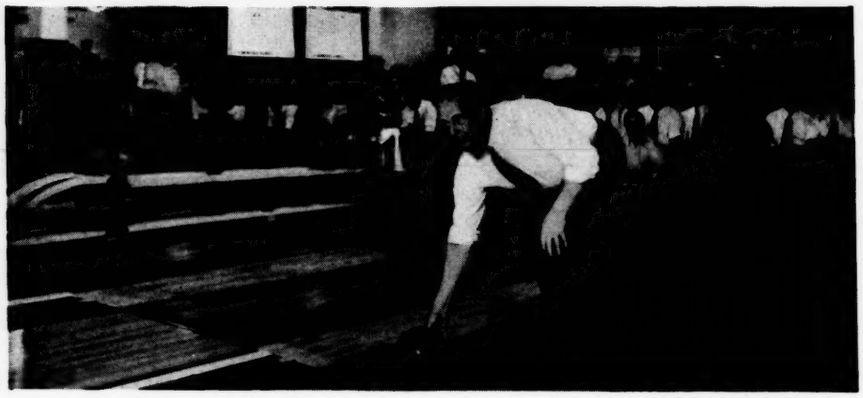
Direction of air flow is the final but not least important point to consider in the construction of the modern dry kiln. For proper and uniform drying it is necessary that the heated air travel the shortest possible distance across the surface of the boards. The farther the air flow the greater becomes the humidity with a corresponding increase in temperature drop. Uneven drying and warping is the result.

A method of arrangement of duct work, and the best in most cases, is to install the supply ducts in the floor so that the air is directed upward into the center of the lumber stack. By stacking the lumber so that there is an inverted V-type flue in the center of the stack the air flow is reduced to one-half that of the width of the stack. Return ducts to the fan are placed in the floor.

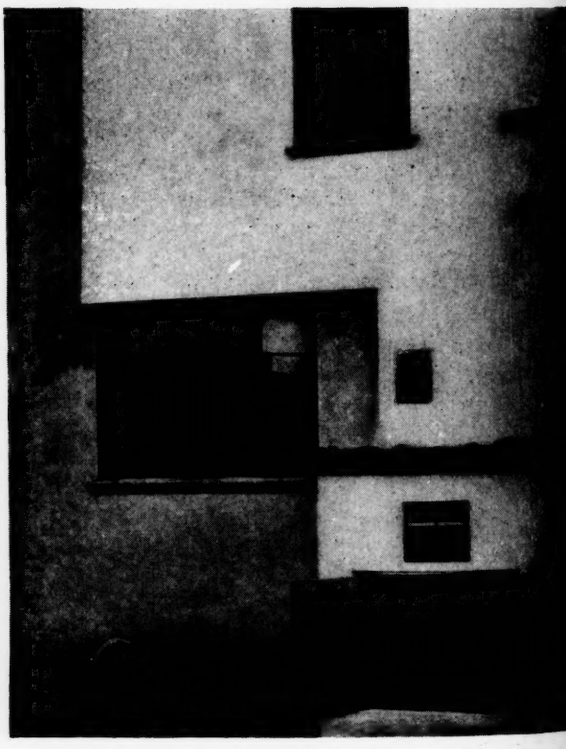
To maintain the proper humidity steam is introduced into the air stream entering the drying chamber.

PICTURE PARAGRAPHS

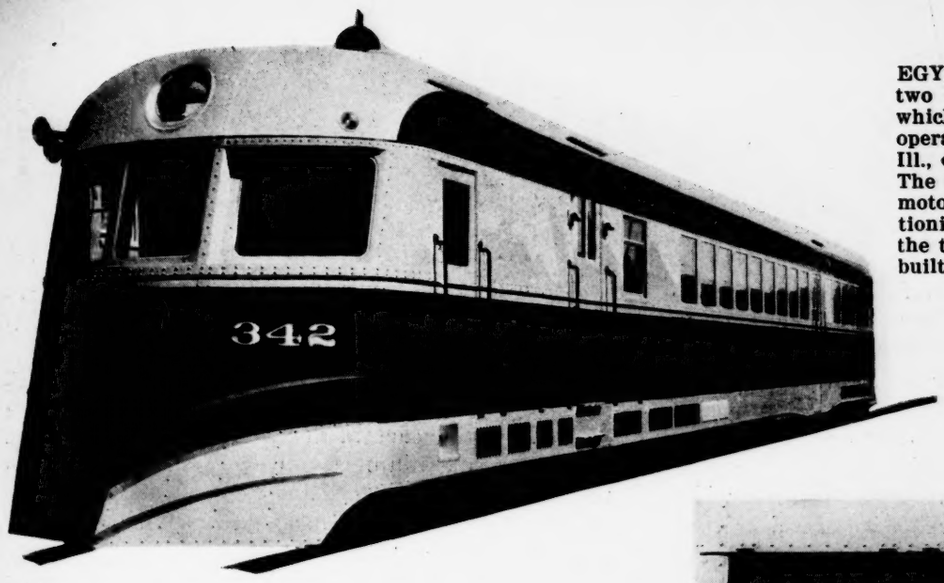
FLUCTUATING AIR PRESSURE within these glass boots aids circulation of the blood in treating gangrene and hardening of the arteries. The boot is made of low-expansion glass by the Corning Glass Works.



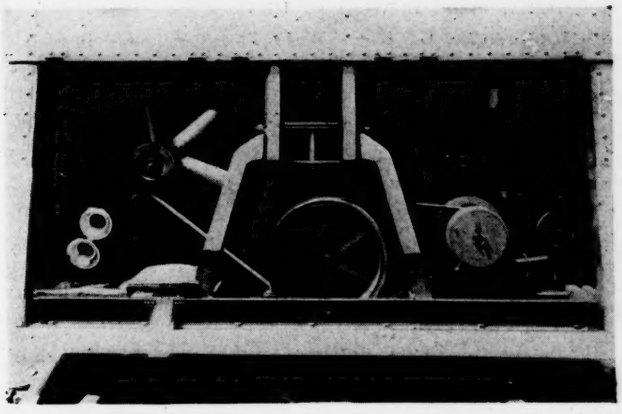
J. F. LINCOLN, president of The Lincoln Electric Co., Cleveland, opens the 1937-1938 bowling season for the Lincoln 24-team league composed of 150 of the company's employes.



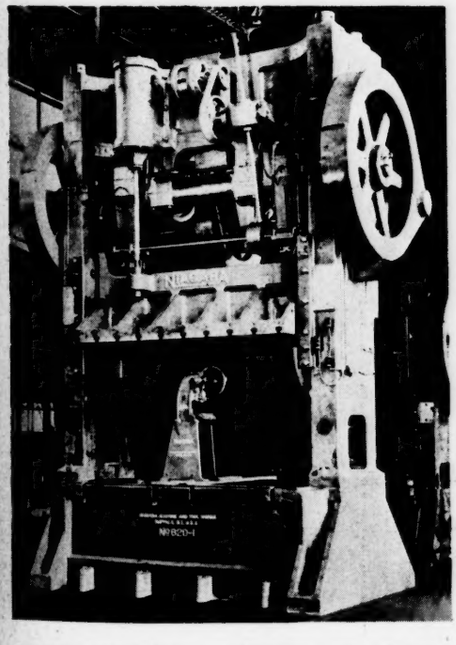
HOME OF BOY IN IRON LUNG (left). Palatial Miami Beach home of Frederick Snite, Jr., for 18 months an infantile par victim. Note ramp for transportation of the iron lung at the left. This facilitates movement of the heavy machine to his (Right) The Carrier air conditioning unit beneath the sickroom of young Snite.



EGYPTIAN ZIPPER is the name of two rail motor coach trains, one of which is shown at the left, which will operate between Danville and Cypress, Ill., on the Chicago & Eastern Illinois. The cars, driven by a 200-hp. gasoline motor, have a 5-ton A.C.F. air conditioning unit mounted in the rear of the train, as shown below. They were built by American Car and Foundry Company at Berwick, Pa.



PRIZE THERMOSTAT (left). The White Manufacturing Company's Technotrol thermostat won second prize in the second annual *Modern Plastics* design competition. The Technotrol was designed by Barnes & Reinecke, of Chicago. It is the first piece of heating and ventilating equipment to win a *Modern Plastics* award.



PRESS WITHIN A PRESS. The large unit is the Niagara double crank press built for a large automotive plant, while the smaller one is a Niagara series A inclinable press.

CONVECTORS IN THE CATSKILLS. In this attractive lodge at Bear Mountain in upstate New York, Trane convectors were installed in 30-in. logs, as shown above, in order to adapt the heating units to the rustic motif.

Steam Jet Operation Control by Flow

By FRANK W. AUCHMOODY†

CONTROL of steam jet refrigeration machines is ordinarily obtained by increasing or decreasing the number of manually-operated booster ejectors in service to match the load as closely as possible and permitting the automatic booster to make up the balance of the load by cutting in and out as the temperature of the chilled water leaving the machine rises and falls. This method of thermostatic control, while satisfactorily operating the machine has the disadvantage of not giving the best economies throughout the entire load range.

Better results can be obtained by carrying a maximum flow of water through the flash tank at all times and varying the temperature to meet the load, rather than a varying rate of flow and a constant temperature. In this way full advantage can be taken of the operating characteristics of this type of machine, and a lowered steam consumption per ton-hour will result while operating under partial loads.

Since dehumidifiers for human comfort air conditioning are subject to partial loads for the greater part of the cooling season, the resultant savings effected by this method of operation would be a substantial one.

For each outlet water temperature from the machine, there is a corresponding absolute pressure which must be maintained in the flash tank. The steam per ton-hour will vary according to this absolute pressure. By maintaining this pressure as high as possible the capacity of a booster ejector is raised due to lesser volume of the vapor at the higher pressure. Operating results show a decided decrease in steam consumption as the absolute pressure in the flash tank is increased.

†Air Conditioning Engineer, Rockefeller Center, Inc., New York.

As an illustration consider a 300-ton steam jet machine operating at 100-ton (1,200,000 B.t.u. per hr.) load or one-third of the maximum capacity. The machine is rated by the manufacturer to deliver a maximum flow of 1200 g.p.m. at 45F returning water to it at 51F. By the usual method of operation and thermostatic control as outlined above, at one-third capacity the dehumidifier would call for a rate of flow of 400 g.p.m. at 45F. The author, however, recommends a maximum flow of 1200 g.p.m. at 49F. Both will deliver the same tonnage, but the steam consumption of the recommended method will show considerable reduction over the usual method of operation. The following computations will show clearly where the economies are effected:

Latent heat of evaporation at 0.3002 in. absolute pressure (45F) = 1066 B.t.u. per lb.

Latent heat of evaporation at 0.3492 in. absolute pressure (49F) = 1064 B.t.u. per lb.

At 45F: $\frac{1,200,000}{1066}$ B.t.u. per hr. to be removed (100 ton) = 1125.7 lb. of water to be evaporated per hr.

At 49F: $\frac{1,200,000}{1064}$ = 1127.8 lb. of water to be evaporated per hr.

The specific volume of water vapor at 0.3002 in. of mercury (29.6989 in. vacuum) is 2033 cu. ft. per lb., and at 0.3492 in. of mercury (29.6499 in. vacuum) is 1763 cu. ft. per lb.

2033 cu. ft. per lb. × 1125.7 lb. of water at 45F = 2,288,548 total volume of vapor to be removed at 0.3002 in. of mercury.

1763 cu. ft. per lb. × 1127.8 lb. of water at 49F = 1,988,311 total volume of vapor to be removed at 0.349 in. of mercury.

$\frac{2,288,548}{1,988,311}$ = 115.1%, or 15.1% more work for steam used.

Obviously, a booster ejector designed by the manufacturer to remove 2,288,548 cu. ft. of vapor and rated 100 tons at 45F, would be capable of 115.1 tons at 49F, due to the lesser volume of the vapor at the absolute pressure of 0.3492 in. of mercury necessary to produce 49F water, as compared to the volume at

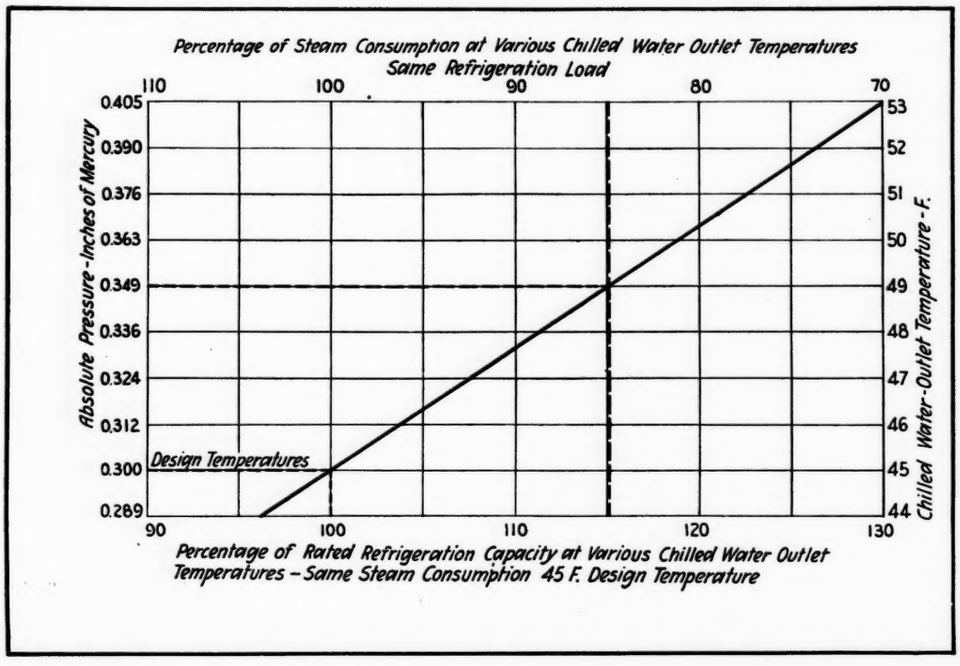


Fig. 1. Steam jet booster operating characteristics.

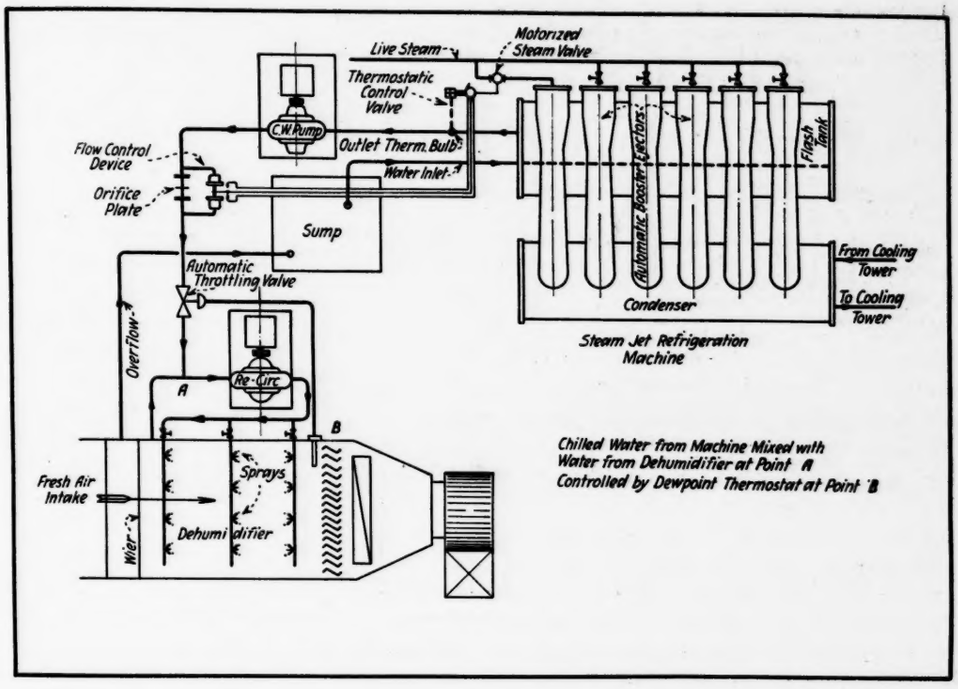


Fig. 2. Flow control method and method of thermostatic control for steam jet refrigeration.

0.3002, which is necessary for 45F water.

Therefore, while it was necessary to have sufficient boosters in service to remove 2,288,548 cu. ft. of vapor when operating at 0.3002 in. of mercury, it would only be necessary to remove 1,988,311 cu. ft. at 0.3492, permitting the substitution of a smaller booster ejector, with a consequent saving in steam consumption and accomplishing the same work. See Fig. 1 for other operating temperatures.

In view of this it is reasonable to assume that a constant maximum flow at the highest possible outlet water temperature from the machine and yet maintain the desired dew point in the dehumidifier, is the better method of operation throughout the entire load range.

In order to achieve the desired results, the author has installed a pressure sensitive device consisting of two metal bellows connected together with a contact arm. Connections were made to the bellows from each side of an orifice plate located in the chilled water line between the discharge pump from the flash tank and the automatic throttling valve on the dehumidifier. Variations in the rate of flow as governed by the dewpoint thermostat and automatic throttling valve exerted pressure on either one or the other bellows making the contact on either the cut-in or cut-out side, thus operating the motorized steam valve on the automatic booster in and out of service as required by the dehumidifier to meet load conditions. Fig. 2 gives the layout of both methods of control.

A difference of 50 g.p.m. in the rate of flow, to cut in and cut out the automatic booster, was decided as offering the best results in this particular case since 1200 g.p.m. was the maximum and 50 g.p.m. was only a small percentage of the total flow. The rate of flow through the flash tank was kept at a nearly maximum point at all times.

Differences of less than 50 g.p.m. were tried but results showed the automatic booster was cutting in and out too frequently for economical operation.

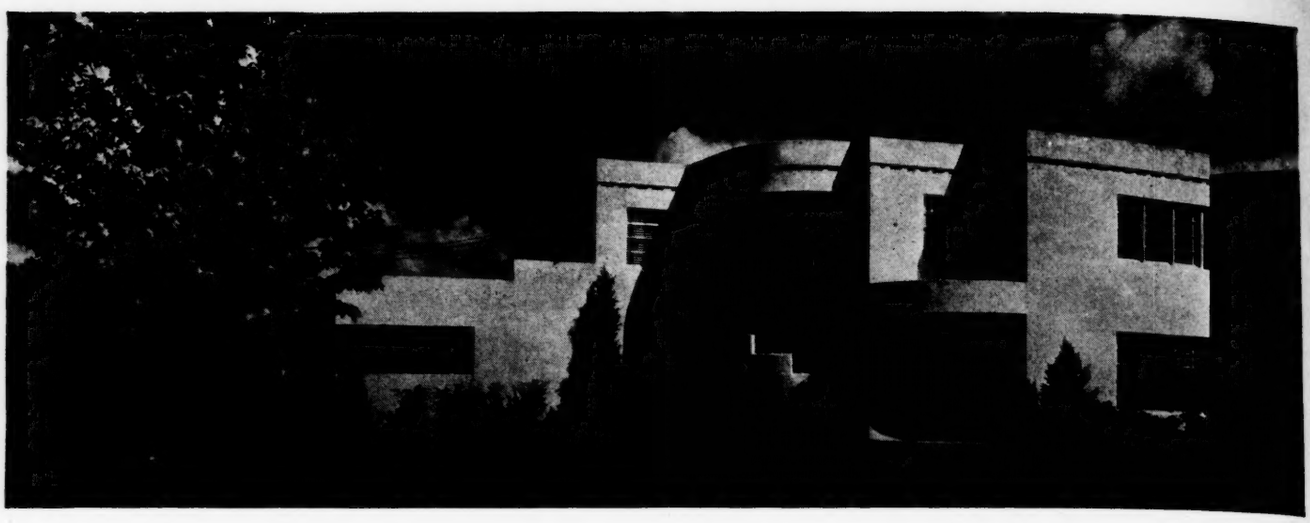
The slightest variation in load conditions could be detected by the operating engineer by observing the flow chart. This left little to guesswork. When the flow reached a maximum point with the automatic booster in service and showed no tendency to decrease, the engineer knew that there were not sufficient boosters in service to take care of the load and remedied this by adding another. The reverse was also true. When the flow of chilled water reached the minimum setting and cut the automatic out of service and still showed no tendency to rise, the engineer could be certain there were too many boosters in service and proceeded to cut one out or substituted a smaller one. In this way positive control was had at all times at a minimum operating cost.

Summer Temperatures for Poultry

SUMMER optimum temperatures for New Hampshire Red laying hens in battery cages were found to range between 75 and 85F for the conditions of a test at the Knights of Malta Home at Lewistown, Pa., according to a report by Geo. W. Robinson, chief ventilating engineer of the Fuel Oil Heating and Service Co., Lakewood, N. J., presented to the American Society of Agricultural Engineers.

The test was run this summer on 1200 birds in battery cages on the ground floor of the house. Observations indicated that when the indoor temperature at night was allowed to drop below 75F the birds became restless, did not sleep well, and dropped off in egg production. When the daytime indoor temperature was allowed to exceed 85F the birds became loggy, tended to roost, consumed less feed, and dropped in both weight and egg production.

During the time of the test outdoor temperatures ran as high as 114F. Average indoor temperature of 78F was maintained in the battery room, which measured 150x30x9.5 ft., by conditioning and circulation of 800,000 cu. ft. of air per hour under 0.5 in. static pressure.



Year-Round Conditioning for Modern Home

WHAT is believed to be the first year-round air conditioning system of its kind has been built into the recently completed home of L. M. Persons, chief engineer of White-Rodgers Electric Co., St. Louis, manufacturer of automatic control equipment. The system is designed on the theory that comfort depends principally on the temperature and humidity around the feet and legs.

The house is an interesting example in modern design and conception, being of concrete construction throughout with generous area of glass brick, unusual indirect lighting systems, and ultra-modern appointments.

The heating unit is a gas-fired conditioner of 125,000 B.t.u. capacity with a 1300 c.f.m. blower, while the calculated heat loss at design conditions is 100,000 B.t.u. per hr. Humidity is supplied by a pan-type humidifier.

The floors are not solid concrete but are built of open web 10-in. steel joists to permit using the floors for plenum chambers. The bottom of each floor is sealed off with concrete, forming the ceiling surface for the rooms below, and the top of each floor is sealed with a single 3-in. concrete slab, laid over the joists and forming the floor surfaces. Both floors are covered with ⅛-in. mastic tile. Concrete slabs forming the floors do not extend to the outside walls but stop 4 in. from them.

Thus with the floors providing the plenum chambers, the winter air is delivered directly into the first floor chamber. A large riser 10 in. wide and 4 ft. long, equipped with a splitter damper to regulate the volume of air, is built into a partition wall and provided for air delivery from the first floor chamber to the second floor chamber.

In winter the heated air is delivered into the rooms through slots in the wall and located 6 in. above the floor level. These slots are 1 in. wide by 15 ft. long and are curved to deflect the air down toward the floor. The large area of these slots admits the incoming air at such low velocity that air movement is imperceptible.

Return air outlets for winter are provided in a "cove" in the walls near the ceiling and at a point about where picture molding would ordinarily be located. The concealed lighting equipment is contained in this same "cove" and the return air openings are just as effectively concealed as the lighting equipment.

Summer cooling equipment employs a 3-ton refrigeration unit. The direction of air flow is reversed through the system in summer, bringing the cool air in at the top of the rooms and letting it settle to the outlets at the bottom.

The living room ceiling is 9 ft., but all other rooms are 8 ft. The house is insulated with 4 in. of rock wool in the side walls and 6 in. in the roof. Above the layer of insulation in the roof is an air space which is vented to the outside by about 300 holes of 3 in. diameter in the side walls. These permit roof heat to be carried off in the summer and lower temperatures in the upstairs rooms.

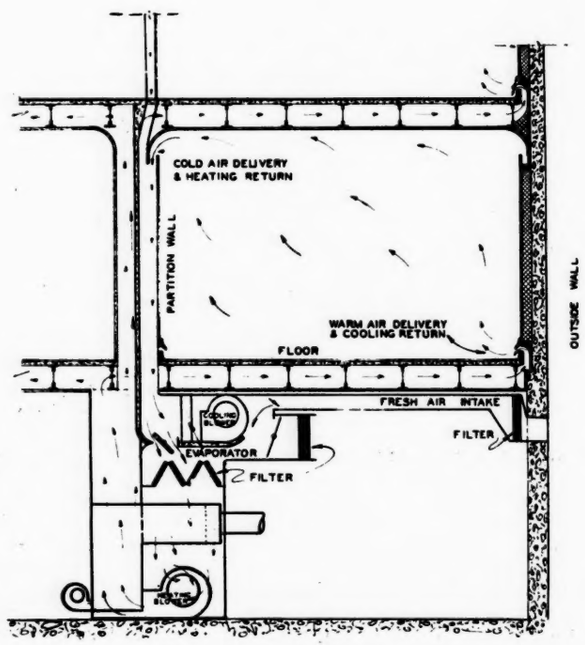


Diagram showing principle of operation of the year-round air conditioning installation in the Persons residence. Note the continuous air inlet in the baseboard and air exhaust near the ceiling. Air is carried in floor and ceiling spaces.

REFRIGERANT PIPING SIZES FOR VAPOR SUCTION LINES

	Ammonia NH_3		Carbon Dioxide CO_2		F12 CCl_2F_2		Methyl Chloride CH_3Cl		Sulphur Dioxide SO_2	
1	2	3	4	5	6	7	8	9	10	11
Nominal Pipe Size (Inches)	Refrigeration load in B.T.U. per hr. (for equivalent tons divide by 12,000) (If suction temperature is under 25F, use column headed 5F; if over 25F use column headed 40F).									
	5F	40F	5F	40F	5F	40F	5F	40F	5F	40F
⅛	—	—	—	—	—	—	—	—	—	—
¼	—	—	—	—	400	600	600	900	500	700
⅜	—	—	—	—	3,600	4,800	6,000	8,400	4,800	6,000
½	24,000	36,000	18,000	24,000	6,000	9,600	9,600	12,000	8,400	10,800
¾	48,000	72,000	36,000	48,000	12,000	20,000	20,000	30,000	18,000	24,000
1	96,000	132,000	60,000	84,000	24,000	36,000	36,000	54,000	32,000	42,000
1¼	144,000	204,000	96,000	132,000	36,000	55,000	60,000	84,000	48,000	66,000
1½	204,000	300,000	144,000	180,000	54,000	80,000	84,000	120,000	72,000	96,000
2	360,000	528,000	240,000	324,000	96,000	138,000	144,000	204,000	120,000	168,000
2½	528,000	756,000	360,000	480,000	132,000	200,000	204,000	300,000	180,000	240,000
3	816,000	1,200,000	540,000	720,000	216,000	312,000	324,000	468,000	288,000	360,000
3½	1,080,000	1,560,000	720,000	984,000	288,000	420,000	444,000	636,000	384,000	480,000
4	1,440,000	2,040,000	960,000	1,272,000	372,000	540,000	576,000	816,000	480,000	648,000
5	2,112,000	3,024,000	1,440,000	1,920,000	530,000	800,000	816,000	1,200,000	720,000	960,000
6	3,264,000	4,800,000	2,160,000	2,880,000	870,000	1,250,000	1,296,000	1,872,000	1,152,000	1,440,000
Max. Velocity .	5,000	3,600	900	700	2,200	1,600	3,800	2,700	4,600	3,000

NOTE:—Lines ⅛" and Less:—Under 25 lin. ft. as tabulated; 26 to 75 lin. ft. use one size larger; 76 to 150 lin. ft. use two sizes larger.
Lines 1" to 2" Inclusive:—Under 50 lin. ft. as tabulated; 51 to 100 lin. ft. use one pipe size larger; 101 to 200 lin. ft. use two sizes larger.
Lines 2½" and Over:—Under 100 lin. ft. as tabulated; 101 to 200 lin. ft. use one pipe size larger; 201 to 300 lin. ft. use two sizes larger.

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SIZING REFRIGERATION PIPING FOR AIR CONDITIONING

Vapor Suction Lines

In selecting pipe sizes for refrigerant lines it is important to keep in mind two points—first that pipe sizes should be kept large to reduce friction losses, and second that they should not be made too large because a low refrigerant velocity will prevent the circulation of the oil. With some refrigerants now commonly used for air conditioning a lubricant is carried around with the refrigerants and if the speed is reduced too much the lubricant will not circulate, bringing about operating difficulties.

The table on the other side of this sheet gives refrigerant pipe sizes for the vapor suction line between the outlet of the cooling coil and the suction side of the compressor. This table is arranged in a form similar to that commonly used for presenting tables for sizing steam and hot water piping. Opposite a column of standard pipe sizes appear figures giving the heat load in B.t.u. per hour suitable for each pipe size for the refrigerant used.

It will be noted that in the table the column listing pipe sizes refers to the "nominal" pipe size. This is the name by which the sizes are designated by most engineers and contractors in the course of ordinary usage. Tubing is commonly ⅛ in. larger in outside diameter than its "nominal" size, while iron and steel standard weight pipe has outside diameters which bear no steady relation to the nominal size. Use of this method of listing the standard pipe sizes permits applying the tables regardless of whether tubing or pipe is being used.

Since the number of turns, obstructions, or fittings affect the size selection, it is necessary to make allowances for their presence. Their number and their effect on the size vary with each installation. A workable single table is one which will prevent excessive pressure drop when allowance is made for a reasonable number of fittings and bends. This allowance has been made in computing the table. Consequently, no additional allowance is necessary unless the number of fittings is excessive, in which case their presence can be compensated for by selecting the next standard pipe size larger than would normally be used. This general procedure insures adequate pipe size and in cases where conditions permit lines straight and short, the ideal of no measurable friction loss in the piping may be approached. The only element of individual judgment is the question of when the number of fittings and turns is really excessive. There is no direct answer to this, but experience and exercise of reasonable judgment will keep errors to a minimum. Keep in mind that the general rule is that it is probably better to err on the side of too large a pipe size rather than too small a size.

Provision is also made in the table for a reasonable method of compensating for excessive lengths of pipe line. In the table footnotes indicate the length of pipe for which the tabulated values should be used and the points where extra allowance should be made. The maximum velocities assumed as allowable in computing the table are shown.

Pipe sizes are shown for cases where the suction line vapor temperature is either 5F or 40F. In the great majority of air conditioning installations the column headed 40F can be used since the suction temperature in such work is seldom lower than 25F. Inclusion of the data for temperatures of 25F to 5F, however, makes the table more comprehensive, permits its use in sizing piping for commercial refrigeration purposes, and gives an idea of how a change in suction gas temperature affects the carrying capacity of the piping.

Use of the table is illustrated in the following examples:

Example 1. A methyl chloride refrigerating system for handling an air conditioning load of 40,000 B.t.u. per hr. has a vapor suction line 33 ft. long. What nominal size pipe should be used?

Solution. Since no specific vapor suction temperature is given, assume that the suction temperature is greater than 25F, and that therefore the solution will be found in column 9 in the division headed Methyl Chloride. Move down this column until a figure equal to or greater than 40,000 is reached, in this case 54,000. Read horizontally to the left to column 1 and find that a 1-in. pipe would be called for. Examine footnote at bottom of table and note that for pipes of 1 in. to 2 in. in diameter the tabulated figures apply up to lengths of 50 ft. of pipe. Since the 33 ft. of pipe line is less than 50 ft., no additional allowance is made and the size selected is 1-in. pipe.

Example 2. What pipe size would be selected for the vapor suction line in Example 1 if ammonia were the refrigerant instead of methyl chloride?

Solution. In column 3 move down to a figure equal to or exceeding 40,000 and find 72,000; move horizontally to column 1 and find that a ¾-in. pipe size would be ample since the 72,000 figure is greatly in excess of 40,000.

Example 3. A refrigerating system using F12 and operating with a vapor suction temperature of 35F on an air conditioning load of 40 tons has a vapor suction line 210 ft. long. What pipe size would be selected?

Solution. The solution definitely falls in column 7. Read down this column to a figure equal to or exceeding 480,000 (equals 12,000 x 40T) and find 540,000 in this case. Move horizontally to column 1 and find the pipe size as 4 in. Refer to the footnote and observe that for vapor suction lines 2½ in. and over, the tabulated values apply only up to 100 lin. ft. of pipe; for lines over 200 ft. long the note instructs to add two pipe sizes. By this rule the required pipe size becomes 6 in. instead of 4 in.

Information on the sizing of liquid refrigerant lines is given on H. & V.'s Reference Data 117 and 118.

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H. & V.'s REFERENCE DATA—116

INDUSTRIAL EXHAUST VENTILATION

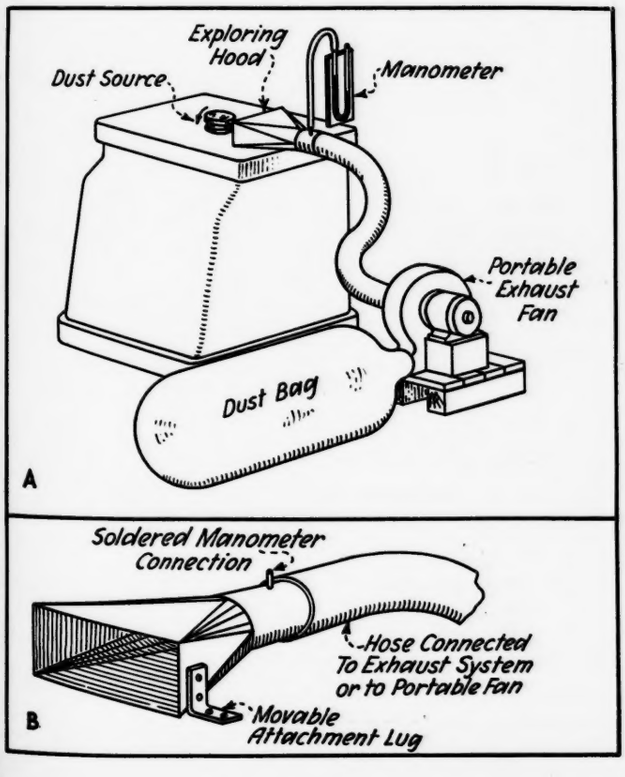
Rate of Air Flow Through Hoods

By JOHN L. ALDEN

THE air volume to be drawn through a hood can be computed only after the general shape and location of the hood are established. The minimum basis for the necessary assumptions is a freehand sketch reasonably true to scale. The preparation of this sketch must take into account most of the factors treated in "Principles of Exhaust Hood Design" (see HEATING & VENTILATING, October, 1937, page 56), and summarized in the following paragraphs.

Unnecessary air contamination should be eliminated at the source. Dust-dispersing air currents should be minimized or should be controlled by baffles or shields.

The hood should draw dusty air away from the operator and away from the breathing zone. Convection currents and other dust-dispersing agencies should be opposed by exhaust currents of greater intensity. The exhaust velocity at all points in the zone of dust generation must exceed the velocity of escape. Hoods handling large particles projected at high speeds must be so located that the material is thrown into the hood mouth. Open hoods similar to Figs. 12 and 13 should be shaped to conform to the area of dust generation and should be proportioned to produce flat velocity contours in this area. The face velocity should be the lowest consistent with the required velocity in the dusty area. Side flanges and baffles promote economy by reducing air flow from the rear of the hood and from other unimportant areas.



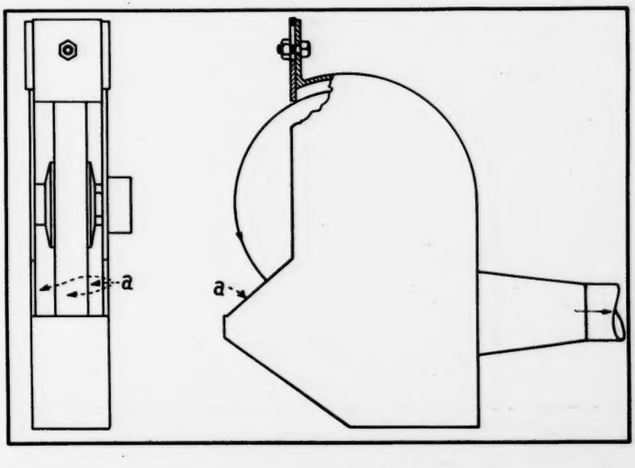
Air Velocities Required at Dust Sources

No general statement can be made as to the velocities required to prevent the escape of dust and dusty air from generating areas. Impact processes such as stone cutting produce trajectories of random directions as well as velocities impossible to measure. Particles thrown from abrasive wheels, on the contrary, follow fairly definite paths. Moreover, their velocities are known to be always less than the tangential velocity of the wheel. The essentials of various dust-generating processes differ so widely as to necessitate individual treatment. No data of consequence have been published concerning dust escape velocities. Therefore, the engineer must lay his own foundation for hood design. This is not as difficult as may be imagined.

Exploring Hoods

The necessary hood face velocities for dust control in a specific situation may be determined experimentally by means of the simple exploratory apparatus shown in Fig. 32. This consists of a simple open hood similar in form to that illustrated in Fig. 13, the velocity characteristics of which may be taken from the diagrams. Its volume rate of flow can be measured and can be plotted against the static suction. When connected to a source of suction the hood can be moved about the

Fig. 32. (Left) A—Portable exploratory apparatus; B—Calibrated exploring hood. Fig. 33. (Below) Grinder hood.



dusty zone until a location is found in which dust control is satisfactory. From the static pressure and the calibration curve the average face velocity may be obtained. The velocity contour characteristics of the hood, combined with the known face velocity, enable the velocity in the dust zone to be estimated.

The exploratory equipment illustrated can be contrived at little expense and will pay for itself in the lessened first cost of a single exhaust system. Moreover, the lower power consumption of the smaller but equally effective system thus obtained represents an additional and continuing saving.

Hood Face Velocities

Average face velocities of from 500 to 1000 f.p.m. are usually sufficient for hoods partially or wholly enclosing the dust source. Most woodworking and grinding hoods fall in this category. Since the velocity distribution across the hood face is seldom uniform, it is best to arrange the structure so that the higher velocities occur in the region where the risk of dust escape is greatest. Thus, at 4500 f.p.m. pipe velocity, the average face velocity of the grinder hood, Fig. 33, ranges from 900 to 1100 f.p.m., depending upon wheel diameter. The velocity through the large opening, *a*, below the wheel is higher than average, measuring from 1100 to 1300 f.p.m. Moreover, the wheel, by its fan action, materially increases the flow through this section, thereby increasing the effectiveness of the hood.

Face velocities have been determined for several hoods handling jute dust. The hood openings were 72 by 1½ in. and were about 3 in. above the surface of a moving mass of loosely matted fiber carried on the feed sheet of a finisher card. The purpose of the exhaust was to carry off the rising dust but to leave behind all usable fiber. When the hoods were adjusted to function properly, the face velocities were found to range from 500 to 660 f.p.m. The velocity at the surface of the fiber mass did not exceed one-half these values.

Two 8 by 8 in. floor sweep openings similar to Fig. 34 were found to have average face velocities of 1790 and 1960 f.p.m. The maximum velocity, approximately 2500 f.p.m., occurred at the lower part of the opening

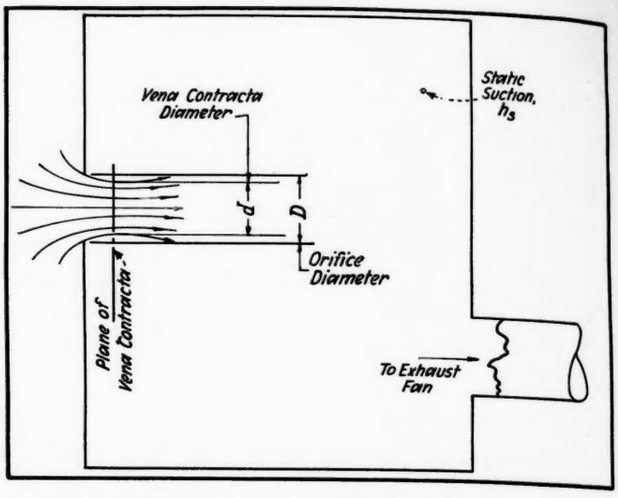
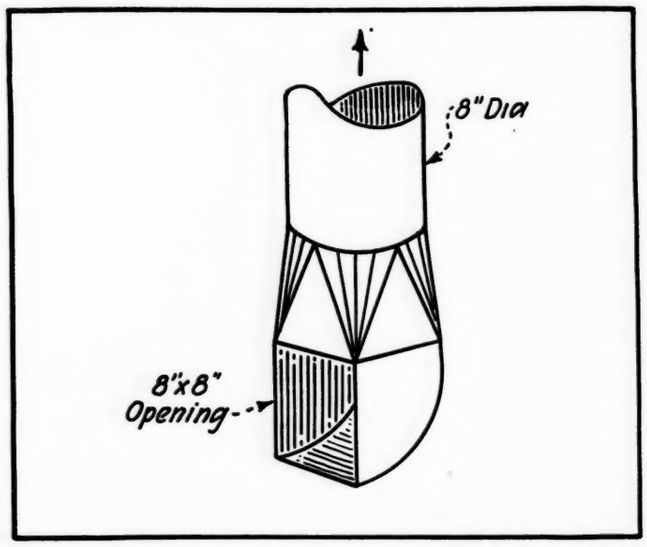


Fig. 36. Flow through elementary thin-plate orifice.

near the floor where the higher velocity is most useful. These velocities were sufficient to handle all ordinary floor sweepings except nails and other tramp iron.

Some experiments in separating stones from coffee beans may be quoted to show that relatively low velocities will pick up fairly heavy particles. A mixture of coffee beans and stones, representing uncleaned coffee, was spread on a coarse meshed wire screen held 1 in. from the mouth of a vertical 5-in. diameter pipe. The largest beans and most of the stones of about the same dimensions were picked up at an average face velocity of 2270 f.p.m. The coffee beans alone were picked up at 1650 f.p.m. The dimensions of the largest beans



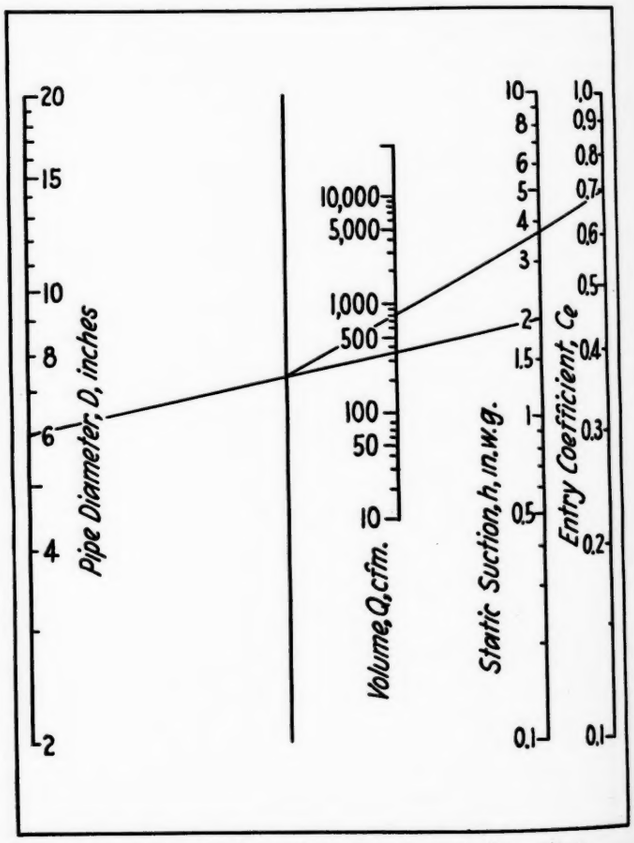


Fig. 34. (Left) Floor sweep nozzle. Fig. 35. (Right) Nomogram for determination of air flow into suction pipes.

were approximately 0.5 by 0.32 by 0.18 in. and the specific gravity was about 0.8.

Pipe Sizes and Hood Suction

Table 3 gives satisfactory pipe sizes and suction for a variety of manufacturing machinery. These values are not necessarily the most economical. Well designed hoods will permit substantial reduction in some instances. Unfortunately, a certain amount of experience is necessary before the tabular figures can be modified successfully. Inspection of systems operating under similar conditions will supply useful data. The engineer should accumulate all possible data from his own industry to enable him to design systems with the lowest safe velocities, pressures and volumes, obtaining thereby the best value for his expenditures.

Air Volume Entering Hood

The volume rate of flow into a hood can be computed from the pipe size, static suction, and a factor which may be termed the coefficient of entry. The coefficient of entry, C_e, may be defined as the ratio of the actual flow to the theoretical as computed from the basic flow formula

$$v = \sqrt{2gH}$$

The volume entering the branch is

$$Q = C_e A V \quad \text{where}$$

Q = volume rate of flow, c.f.m.
A = area of branch pipe, sq. ft.
V = velocity corresponding to static pressure in pipe if completely converted to velocity pressure, f.p.m.

When the static suction is measured in inches of water,

$$V = 60\sqrt{\frac{2gWh}{12w}} = 4008\sqrt{h} \quad \text{where}$$

TABLE 3—BRANCH PIPE SIZES AND STATIC SUCTION AT HOOD†

A—Woodworking Machinery

Machine	Size		Branch Pipe No.	Branch Pipe Dia., In.	Static Suction, In. Water
Single Planers	Knife Length, Inches	Up to 20	1	5	1.50
		Over 20 to 26	1	6	1.50
		Over 26 to 36	1	7	1.75
		Over 36	1	8	1.75
Double Planers	Knife Length, Inches	To 20, Top head	1	5	1.50
		To 20, Bottom head	1	4½	1.50
		20 to 26, Top head	1	6	1.75
		20 to 26, Bottom head	1	5	1.50
		26 to 36, Top head	1	7	1.75
		26 to 36, Bottom head	1	6	1.50
		Over 36, Top head	1	8	2.00
		Over 36, Bottom head	1	7	1.75
Single Drum Sanders	Surface, Sq. In.	Up to 200 sq. in. surface and 10 in. dia.	1	3	1.50
		Under 400 sq. in. surface, over 10 in. dia.	1	4	1.50
		Over 400 to 700	1	4½	1.75
		Over 700 to 1400	1	5	1.75
		Over 1400 to 2400	1	6	2.00
Spindle Sanders	—		1	3	1.50
Triple Drum Sanders	Drum Length, In.	Up to 30, each roll	1	6	2.00
		Over 30 to 42, each roll	1	7	2.25
		Over 42 to 48, each roll	1	8	2.50
		Over 48 to 60, each roll	1	10	2.50
		Brush roll	1	5	2.00
Horizontal Belt Sanders‡	Width, Inches	Up to 6, Top	1	4	1.50
		Up to 6, Bottom	1	4	1.50
		Over 6 to 9, Top	1	4	1.50
		Over 6 to 9, Bottom	1	4½	1.50
		Over 9 to 14, Top	1	4½	1.75
		Over 9 to 14, Bottom	1	5	1.75
		Over 14, Top	1	5	2.00
		Over 14, Bottom	1	7	2.00
Vertical Belt Sanders	Width, Inches	Up to 6	1	4	1.50
		Over 6 to 9	1	4½	1.50
		Over 9 to 14	1	5	1.75
		Over 14	1	7	2.00
Arm Sanders	—		1	4	2.00
Disc Sanders	Diameter, In.	Up to 12	1	3½	1.50
		Over 12 to 18	1	4	1.50
		Over 18 to 26	1	5	1.50
		Over 26 to 32	1	6	1.50
		Over 32 to 38	2	4½	1.75
		Over 38 to 48	2	5	2.00

†Consult state exhaust code for specific requirements.
‡For bottom run of belt; if top run is used, omit top pipe.

Machine	Size		Branch Pipe No.	Branch Pipe Dia., In.	Static Suction, In. Water
Rip, Table, Mitre, Cut-Off and Variety Saws	Diameter, Inches	Up to 16	1	4	1.25
		Over 16 to 24	1	4½	1.25
		Over 24	1	5	1.25
Variety Saw with Dado Head	—		1	5	1.25
Swing Saws	Diameter, Inches	Up to 20	1	4	1.25
		Over 20	1	4½	1.25
Self-Feed Table Saws	Diameter, Inches	Up to 16	1	4½	1.50
		Over 16	1	5	1.50
Self-Feed Rip Saw, Wet Lumber	Diameter, Inches	Over 24	1	6	2.00
Gang Rip Saws	Diameter, Inches	Up to 24	1	5	2.00
		Over 24 to 36	1	6	2.00
		Over 36 to 48	1	7	2.00
		Over 48	1	8	2.00
Band Saws	Blade Width, In.	Up to ½	1	3	1.25
		Over ½ to 1	1	3½	1.25
		Over 1 to 2	1	4	1.50
		Over 2 to 3	1*	5	1.50
		Over 3 to 4	1*	6	1.50
		Over 4 to 6 (Resaw)	2	7 and 4½	2.25
		Over 6 to 8 (Resaw)	2	8 and 5	2.25
Jig Saws	—		1	3 to 4	1.25
Sash Stickers	Each head		1	4	1.75
Jointers	Knife Length, Inches	Up to 6	1	3½	1.50
		Over 6 to 12	1	4	1.50
		Over 12 to 20	1	4½	1.50
		Over 20	1	5	1.50
Moulders, Matchers, and Sizers	Knife Length, Inches	Up to 6, Top head	1	4½	2.00
		Up to 6, Bottom head	1	4	1.75
		Up to 6, Side head	1	4	1.75
		Over 6 to 12, Top head	1	5	2.00
		Over 6 to 12, Bottom head	1	4½	1.75
		Over 6 to 12, Side head	1	4	1.75
		Over 12 to 18, Top head	1	6	2.00
		Over 12 to 18, Bottom head	1	5	2.00
		Over 12 to 18, Side head	1	4½	2.00
		Over 18 to 24, Top head	1	7	2.00
		Over 18 to 24, Bottom head	1	6	2.00
		Over 18 to 24, Side head	1	5	2.00
		Over 24, Top head	1	8	2.00
		Over 24, Bottom head	1	7	2.00
		Over 24, Side head	1	6	2.00

*Sometimes equipped with 3½ or 4 in. pipe on up-run side of blade at lower wheel.

TABLE 3 (CONTINUED) BRANCH PIPE SIZES AND STATIC SUCTION AT HOOD†

B, C & D—Shoe, Leather, Laundry, & Felt Hat Machinery

Machine	Branch Pipes		Static Suction, In. of Water
	No.	Dia., In.	
B—Shoe and Leather Machinery			
Shoe Machinery			
Pound Down	1	4½	3.0
Heel Scourer	1	5	3.0
Bottom Scourer	1	5	3.0
Tip Scourer	1	5	3.0
Breast Scourer	1	4	3.0
Top Piece Scourer	1	5	3.0
Inner Sole Sander	1	5	3.0
Counter Skiver	1	5	3.0
Sole Buffer	1	5	2.0
Edge Trimmer	1	5	3.0
Heel Trimmer	1	5	3.0
Brushes, Single, 3 In. Wide	1	3½	2.0
Brushes, Double, 10 In. Wide	1	4	2.0
Edge Finishing, Gas Fumes	1	2	2.0
Leather Machinery			
Shaving, 12 In. Knives	1	7	2.0
Buffing, 12 In. Knives	1	7	2.0
C—Laundry Machinery			
Flat Work Ironers			
Cylinder	2	16	0.10
Chest Type, 4 to 6 Roll	2	14	0.10
Chest Type, 8 Roll	2	16	0.10
Rotary Ironer			
Up to 12 In. Long Roll	1	4	0.10
Over 12 In. to 16 In.	1	5	0.10
Over 16 In. to 30 In.	1	6	0.10
Over 30 In. to 36 In.	1	8	0.10
Collar and Cuff Machines			
Collar Ironer, 40 In. Long Roll	1	10	0.10
Cuff and Neck Band Presses	1	6	0.10
D—Felt Hat Machinery			
Front and Back Shop			
Crown Pouncing	1	5	3.0
Brim Pouncing	1	4	3.0
Fur Preparing			
Pulling Machine	1	4	2.0
Shearing Machine	1	4	2.0
Brushing Machine	1	5	2.0
Cutting Machine	2	3 and 5	2.0
Fur Blowing Machine	1	10	2.0
Tumbling Cages	1	8	2.0

†Consult state exhaust code for specific requirements.

E—Miscellaneous Machinery

Machine	Branch Pipes		Static Suction, In. of Water
	No.	Dia., In.	
Textile Machinery—Jute			
Bagging Pickers	1	12	1.00
Breaker Cards, Dust Hopper 6 In. x 72 In.	1	9	0.75
Finisher Cards, Cylinder 72 In. x 48 In.	1	6	1.00
Dust Shaker	1	6	1.25
Printing Machinery			
Linotype Lead Pots	1	4	0.10
Stereotype Kettles	1	8	0.10
Tire, Tube and Hard Rubber Machinery			
Buffing Wheels, Up to 9 In. Dia.	1	3	2.00
Buffing Wheels, Over 9 to 16 In.	1	4	2.00
Buffing Wheels, Over 16 to 24 In.	1	5	2.00
Hard Rubber Dust Grinding Wheels, 18 In. Long	1	7	2.00
Rubber Band Machinery			
Tube Dusting Table	1	9	2.00
Blowout Table	1	9	2.00
Jar Ring Dusting	1	4	2.00
Granite Working Tools‡			
Each, Not Less Than 24 Sq. In. Inlet Area	—	5½	4.00
Flint Grinding (Feldspar and Limestone)			
Crushers, Enclosed	1	9	2.00
Ball Mills, Enclosed	1	9	2.00
Pearl Button Machinery			
Carvers	1	2	2.00
Domers	1	3	2.00
Saws	1	4	2.00
Cutting Lathes	1	2	2.00
Drills	1	2	2.00
Pottery Machinery			
Lathes, Electric (Porcelain)	1	3-4	2.00
Fettling Tables	1	4	2.00
Brushing Hood	1	4	2.00
Cleaning Tables	1	6	2.00
Bedding Tables	1	5	2.00
Knockdown Machine (Chinaware)	1	12	2.00
Lithograph Transfer Tables, Dusters, Flouring and Cleaning Machine	1	5	1.00
Fur Dressing Machinery			
Tumbling Cages	1	8	2.00
Hair Plucking Machine	1	4	2.00
Shearing Machine	1	6	2.00

‡Useful as a rough guide only; State of N. Y. Dept. of Labor Industrial Bulletin, No. 12, page 19.

W = weight of 1.0 cu. ft. of water at 68F = 63.32 lb.
g = acceleration due to gravity = 32.17 ft. per sec.^{2}
h = static pressure in pipe, in. water,
w = density of standard air, = 0.07488 lb. per cu. ft.

The volume entering the branch then becomes

$$Q = 4008\ C_c A \sqrt{h}$$

from which the nomogram in Fig. 35 has been constructed.

Coefficient of Entry

The physical significance of the coefficient of entry is worthy of brief consideration. In Fig. 36 is shown a thin-walled sheet metal box under suction into which air flows from the atmosphere through a round hole in one wall. The outer filaments of the entering stream curve inwardly at the plane of the orifice and maintain their convergence for some distance downstream. Consequently, the diameter of the jet a short distance within the box is somewhat smaller than the diameter of the orifice through which it entered. The plane in which the jet has parallel boundaries locates the "vena contracta" or region of smallest jet diameter.

The velocity at the vena contracta is very nearly that to be expected from theoretically perfect conversion of pressure to velocity. Since this velocity is present only over the reduced area of the vena contracta, it is evident that the velocity in the plane of the orifice will be lower in inverse proportion to the areas. The vena contracta velocity is about 97½% of that calculated from the expression $V = 4008\sqrt{h}$ and the vena contracta area is found to be about 62% of that of the thin plate orifice. The flow through the orifice, then, is

$$Q = 0.975 \times 0.62 \times 4008\ A \sqrt{h}$$

where A is the orifice area and h is the pressure in the box. For thin plate orifices, the coefficient of entry is about 0.60.

TABLE 3 (CONCLUDED) BRANCH PIPE SIZES AND STATIC SUCTION AT HOOD†

F—Abrasive Wheels, Discs, and Belts

Type of Abrasive	Size		Branch Pipes		Static Suction, In. of Water
	Diameter, Inches	Thickness, Inches, Not Over	No.	Dia., In.	
Grinding or Abrasive Cutting-Off Wheels‡	Up to 9	1½	1	3	2.00
	Over 9 to 16	2	1	4	2.00
	Over 16 to 19	3	1	4½	2.00
	Over 19 to 24	4	1	5	2.00
	Over 24 to 30	5	1	6	2.00
	Over 30 to 36	6	1	7	2.00
Buffing, Polishing, and Scratch Brushing Wheels‡	Up to 9	2	1	3½	2.00
	Over 9 to 16	3	1	4½	2.00
	Over 16 to 19	4	1	5	2.00
	Over 19 to 24	5	1	5½	2.00
	Over 24 to 30	6	1	6½	2.00
Horizontal Single Spindle Disc Grinders	Up to 12	—	1	3	2.00
	Over 12 to 19	—	1	4	2.00
	Over 19 to 30	—	1	5	2.00
	Over 30 to 36	—	1	6	2.00
Horizontal Double Spindle Disc Grinders	Up to 19	—	1	5	2.00
	Over 19 to 25	—	1	6	2.00
	Over 25 to 30	—	1	7	2.00
	Over 30 to 53	—	2	6	2.00
	Over 53 to 72	—	4	8	2.00
Vertical Single Spindle Disc Grinders Where top of disc is covered not less than half.	Up to 20	—	1	4½	2.00
	Over 20 to 30	—	2	4	2.00
	Over 30 to 53	—	2	6	2.00
	Over 53 to 72	—	2	8	2.00
Vertical Single Spindle Disc Grinder Where top of disc is uncovered.	Up to 20	—	2	4	2.00
	Over 20 to 30	—	2	5½	2.00
	Over 30 to 53	—	4	6	2.00
	Over 53 to 72	—	5	7	2.00
Belts and Abrasive Straps	Up to 3 in. wide		1	3	2.00
	For each 2 in. increase in width over 3 in., add ½ in. to pipe diameter.		1	—	2.00

†Consult state exhaust code for specific requirements.
‡For each increase in wheel width over values listed, increase diameter of branch pipe 0.3 in. to next larger ½ in.

The coefficient of entry is identical in value with the coefficient of discharge for the same form of orifice or nozzle. In both cases, of course, flow takes place in the direction of pressure drop. The term "coefficient of entry" is more descriptive of flow conditions at suction hoods and will be used, therefore, in preference to the more common hydraulic designation.

Typical Orifices and Nozzles

In Fig. 37 are arranged the more common forms of orifice in order of descending entry coefficients. The thin-plate orifice just described is shown in its more customary form at (g). The outline of the jet and the vena contracta are indicated by the flow lines. If the jet be confined within solid boundaries conforming to its free shape, the orifice becomes the well-rounded nozzle illustrated at (a). In this form the jet does not leave the pipe wall and the diameter of what would otherwise be the vena contracta now becomes the pipe diameter. Straighten the smooth flowing curved lines of the well-rounded nozzle and we have the flanged cone inlet at (b). Contract the conical side and the flanged pipe (c) results. The unflanged cone, (d), is a less refined form of (b). Likewise, the loss of the flange from c produces the plain pipe inlet (e).

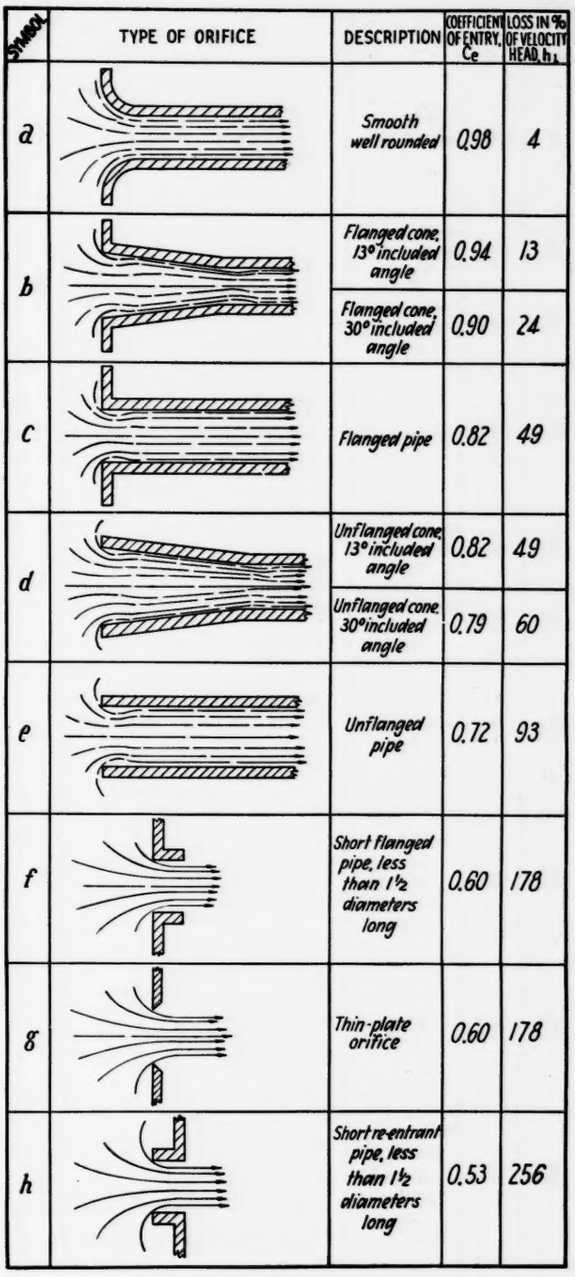


Fig. 37. Properties of orifices and nozzles.

Even without supporting experimental facts, intuition would tell us that the bell-mouthed orifice, (a), would have a coefficient approaching unity since the jet conforms to its solid envelope and no vena contracta is formed. In the flanged cone inlet, (b), a small vena contracta is formed at the junction of the flange and the cone. A second contraction occurs where the cone joins the pipe. These combine to reduce the flow somewhat so that a lower coefficient is to be expected.

Because of the more acute angle between flange and pipe in form (c), the jet contraction is still greater, resulting in a still lower coefficient. The unflanged cone and the plain inlet pipe present still greater contractions and, therefore, progressively lower entry coefficients.

The coefficients of entry of orifices (a) to (e), inclusive, have been based on the pipe area at the cylindrical section. Since (f), (g) and (h) constitute ori-

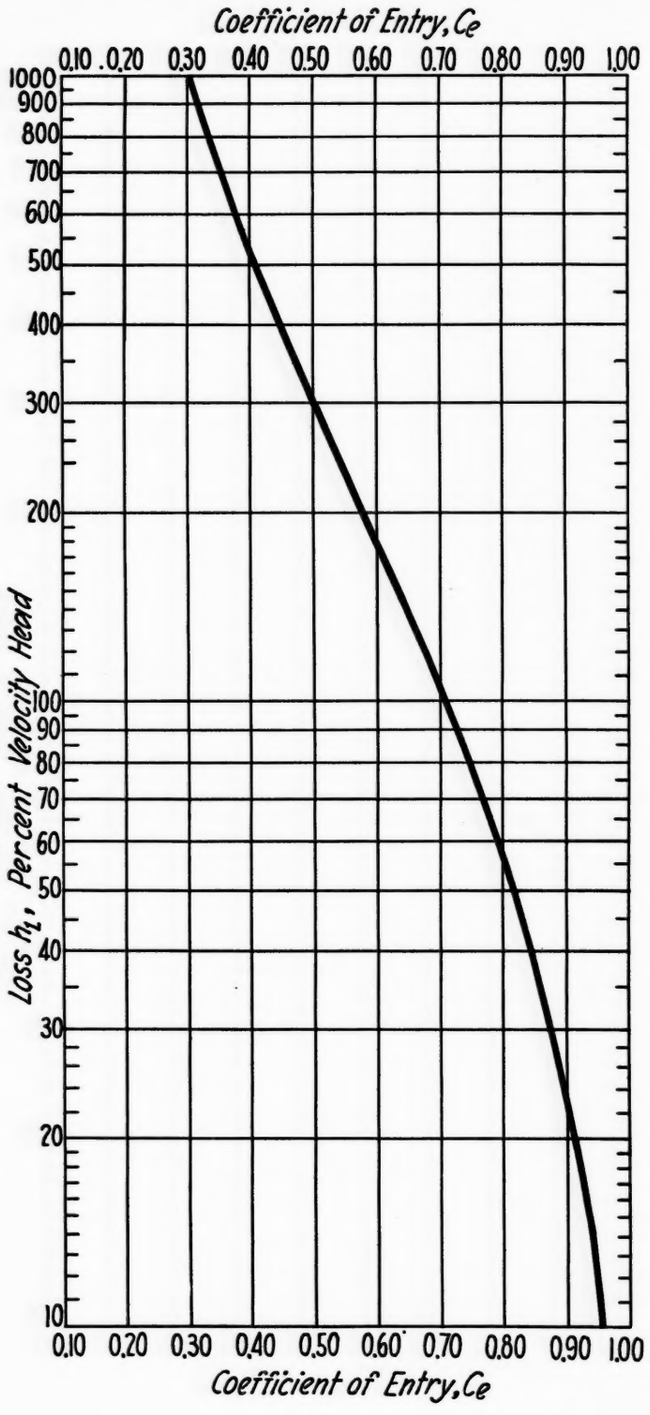


Fig. 38. Orifice losses expressed in velocity head corresponding to values of entry coefficient.

fices discharging into large chambers, the coefficients are calculated from the area of the orifice proper. In each case the jet is heavily contracted. Type (f) differs from (c) in that the cylindrical pipe is too short to permit expansion of the jet and conversion of pressure. Its coefficient therefore becomes the same as that of the thin-plate orifice, (g). Contraction of the jet entering the short re-entrant pipe, (h), sometimes called Borda's mouthpiece, is greater than that of other forms such as (f) or (g). Hence the coefficient of entry is lower.

The loss at entry h_L expressed in percentage of the velocity head, has been included in Fig. 37 and plotted separately in Fig. 38. This factor is useful when it is necessary to find the suction required to produce a given average velocity at the pipe mouth. The coefficient of entry, on the other hand, is convenient when the static suction is known and the pipe velocity is required.

Examples: Pipe form (e), Fig. 37.

$$C_e = 0.72$$
$$h_L = 0.93\ h_v$$

Given; average pipe velocity, V = 4000 f.p.m.

$$h_v = 1.0 \text{ in. water.}$$
$$h_L = 0.93 \times 1.0 = 0.93 \text{ in. of water.}$$
$$h_s = 1.0 + 0.93 = 1.93 \text{ in. of water.}$$

Given; static suction, $h_s = 2.0$ in. of water.

$$V = 0.72 \times 4008 \sqrt{2.0}$$
$$= 4080 \text{ f.p.m.}$$

The well-rounded nozzle, (a), and the thin-plate orifice, (g), are used extensively for metering purposes, consequently, their properties have been investigated thoroughly. The coefficients of the other forms are not so well established. Square and rectangular openings, also, require further investigation. Nevertheless, the values quoted in Fig. 37 for round pipes and openings may be used without serious error when estimating flow into rectangular hoods and pipes. The agreement will be closest when the ratio of sides is 1 : 1.

Design Conditions for Farm Buildings

SOME design conditions for air conditioning systems in farm buildings were given by Prof. F. L. Fairbanks of Cornell University in a paper presented before a meeting of the North Atlantic Section of the American Society of Agricultural Engineers held recently in Toronto.

It should be noted that these values are approximate only. In the table the air flow is given as zero for apples, potatoes, cabbage, and squash. Provision should be made for airing out these storages at certain times, but a continuous air flow is not desirable.

Application	Air Flow, C.F.M.	Temperature, F	Relative Humidity, %
Dairy cattle	60 per head	45—60	75—80
Calves	15 per head	50—60	40—60
Hens	1 per hen	20—50	50—90
Apples	0	30—32	80—85
Potatoes	0	37—40	90
Cabbage	0	32—40	90—98
Squash	0	40	50—70

Air Conditioning Problems in the Citrus Fruit Industry

By HERBERT BISHOP ADDINGTON†
Consulting Engineer, New York.

Air conditioning has played an increasingly important part in preparing the citrus fruits for the market in recent years and bids fair to become of even more importance in the future. The author, who has been closely associated with the application of air conditioning to this industry on the West Coast, describes the methods now used and gives data on time and heat quantities.

ENORMOUS strides in bringing the citrus fruits to the markets in a tree-fresh condition have caused a corresponding increase in the volume of production within the past score of years. At least six states now produce appreciable quantities of these fruits and the original producers are still increasing their acreage. No small part of this expansion has been due directly to the improvement of the atmospheric conditions provided for the fruit while it is in storage and curing. From the time the fruit is delivered to the packing house until it is unloaded at the terminal, it is continuously in a specially prepared atmosphere.

Characteristics of All Citrus Fruits

The diagrams in Fig. 1 explain the sequence in the handling of oranges and lemons respectively. Grapefruit is handled in a manner very similar to lemons but is usually not stored for so long a period. The essential differences between the handling of oranges and lemons depend upon two factors, viz., the former deteriorate in storage and must be used without great delay and the demand is seasonal, while lemons keep well and are necessities with year-round demand.

Oranges are picked at maturity, as nearly as possible, but it is necessary to pick all the fruit in each grove at one time; hence the fruit reaches the packing plant in varying degrees of ripeness. The fruit upon reaching the packing plant is immediately placed in "coloring rooms" where it is further matured by subjecting it to an atmosphere containing the hydrocarbon ethylene in small amounts and a constant temperature. After maturing is completed, the fruit is washed, dried, graded, and packed for shipment. It is modern but not invariable practice to place the packed fruit in refrigerated "precooling rooms" until its temperature has been brought down to 34F after which it is placed in refrigerator cars for shipment. Precooled fruit makes the journey to the market without re-icing of the cars whereas the uncooled fruit requires the refilling of the ice-bunkers at many points along the route.

Lemons, on the other hand, are picked for size and are usually delivered to the packing plant in an immature condition. They are washed, dried, and sorted for ripeness upon receipt. The very ripe fruit may be packed and shipped immediately and some of the rest may be ripened in "coloring rooms" with ethylene when there is a need for immediate shipment. Most of the lemons however are sent from the sorting tables to the lemon storage rooms which are usually refrigerated except in certain districts in which wet bulb cooling is sufficient. The fruit ripens in storage without ethylene

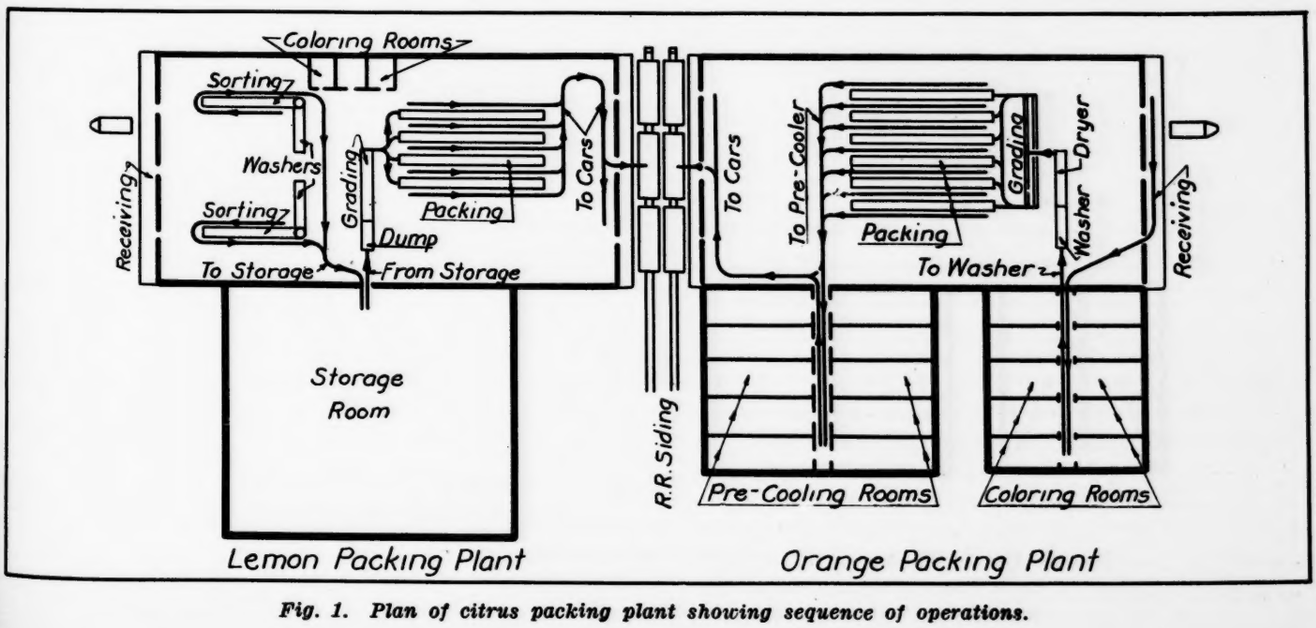


Fig. 1. Plan of citrus packing plant showing sequence of operations.

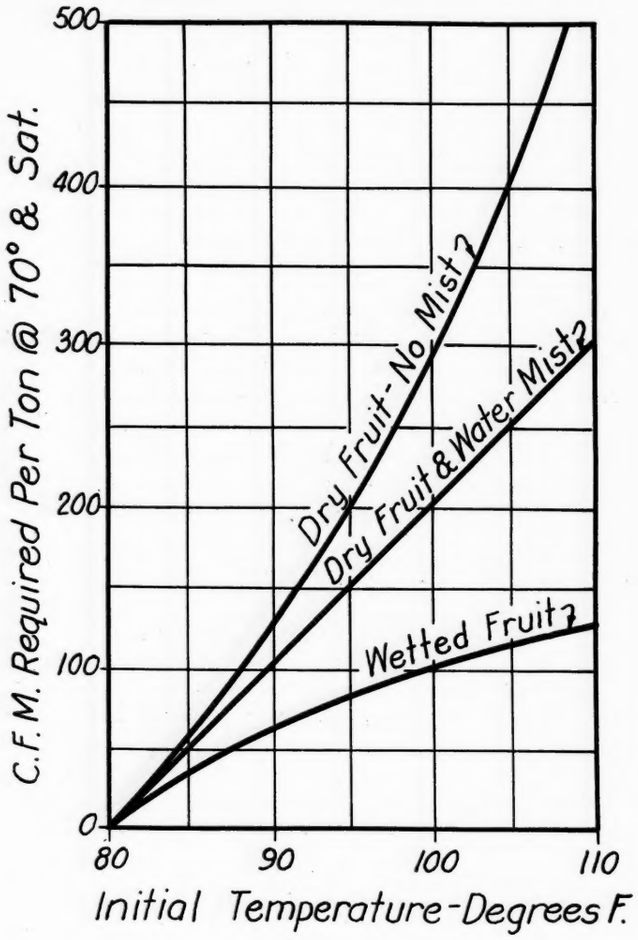


Fig. 2. Air required to cool oranges to 80F.

and is ultimately withdrawn, packed, and shipped as are oranges except that they are never precooled.

All citrus fruit "respires," using up oxygen and producing carbon dioxide and traces of aromatic gases of very complex natures. The rate of respiration is a function of the temperature; at precooler temperature it is practically zero. The rate is increased by the presence of ethylene in the atmosphere. Since the fruit is adversely affected by the products of respiration, ventilation is a necessity. In respiring, the fruit releases heat. Citrus fruit also sweats; its internal moisture penetrating the skin constantly to replace moisture lost by evaporation from the surface. The loss of weight and loss in appearance due to excessive evaporation reduces the monetary value of the fruit. Oranges may be subjected to temperatures of a few degrees below freezing without damage but lemons which have been below 55F will spoil rapidly when exposed to higher temperatures.

Conditioning of Oranges

Coloring rooms are usually designed to be about twice as deep as they are wide; to take 14,000 to 18,000 field lugs of 50-lb. capacity in tiers of 6 or 7 boxes high; with one end closed by a canvas curtain or, in some cases, a folding partition. The rooms are usually 11 to 13 ft. high and they are commonly basement rooms but are not insulated. During coloring, these rooms must be maintained at a uniform temperature and constant relative humidity. Temperatures vary from 70 to 80F, the latter providing the greater rapidity in curing and being the more common. Relative humidities of 85 to 90% are usually preferred depending upon certain characteristics of the fruit during the season. The CO_2 content must be limited to not more than 2% by volume by "blowing-out" the room at periodic intervals and it is customary to try to maintain a maximum of 1%. Since the fruit goes directly to these rooms from the field, it may have a temperature between 35 and 105F. It is usually required that the fruit in each room be brought to proper coloring temperature overnight, i.e., in 14 hr.

There is a greater variation in methods of air conditioning coloring rooms than exists in any other portion of the citrus processes, centering mostly about the problem of preventing excessive drying of the fruit. Steam atomizers are effective in maintaining humidity in the room during coloring and in warming up cold fruit, but lower the efficiency of the cooling system with hot fruit. Water atomizers, or mist nozzles, are generally in use with better economy when cooling down but a loss of economy in warming up and in coloring. The great amount of air leakage through the canvas curtain causes an excessive loss of humidity in all cases which must be replaced by vapor or by water plus the heat of vaporization. Formerly, it was the general practice to wet the fruit under a water spray before it was placed in the rooms and to depend upon this external film of water to protect the fruit against drying. Very hot fruit is now generally sprayed in this manner but additional humidifiers are provided as well. Cooling-down and blowing-out is done by means of an ample supply of saturated air furnished by a common air washer and blower through valved outlets in each room. Steam coils are usually provided in each room when water atomizers are used. The heat losses through the walls in very cold weather rarely exceed

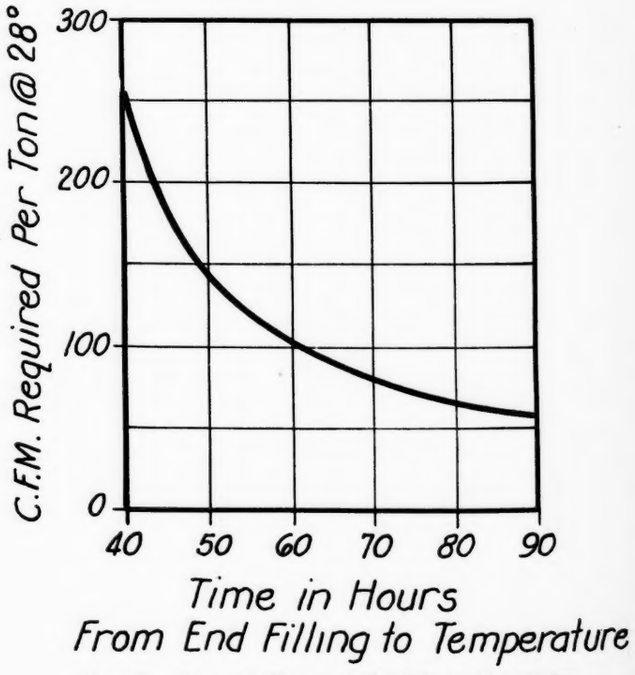


Fig. 3. Air and time required to cool oranges 80F to 34F.

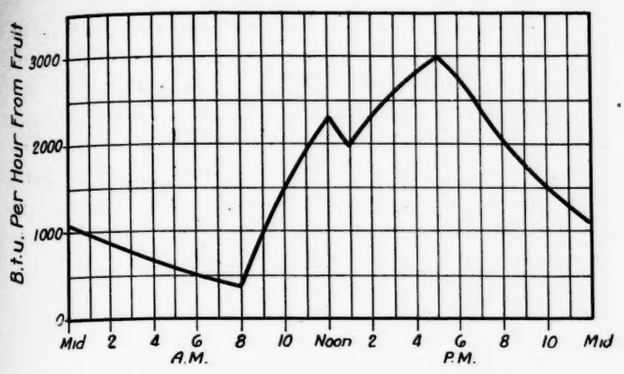


Fig. 4. Heat added to lemon storage space by adding one ton per day of 80F fruit to 57F room.

the heat produced by respiration but 100 sq. ft. of coil surface and up are required to furnish the necessary heat of vaporization and to speed up the warming-up process.

Fig. 2 gives the minimum quantities of saturated air per minute required per ton of fruit to cool from various temperatures to 80F in 14 hr., using 70F air. The extent of evaporation from the fruit is indicated roughly by the following table, based upon the momentary maxima when the fruit is at 100F and at the recommended air quantities from the chart:

Dry fruit and no mist	1.20 ins. V.P. diff.	Index	100
Wetted fruit—no mist	0.79 ins. V.P. diff.	Index	000
Dry fruit and mist	0.93 ins. V.P. diff.	Index	78
80 deg. 88% R.H.	0.125 ins. V.P. diff.	Index	10

With wetted fruit the evaporation is from the surface film only, hence the index is zero. The final condition is that of the coloring process which lasts from 36 to 72 hr.

Precooler rooms are usually about three times as long as they are wide. They are designed to have such capacities that each day's shipment shall empty a whole number of rooms. The sizes range from 2 to 8 cars per room as a rule. They are constructed as refrigerators with well-insulated walls, and tight doors. The ratio of heat extracted from the fruit to total refrigeration is very high. Oranges are taken from the coloring rooms, washed in hot water and dried under air blast with resultant cooling, packed, and reach the precooler usually at a temperature a little below 80F. In the precooler, the temperature of the fruit is to be reduced to 34F. Precoolers are usually rated as 48-hr., 72-hr., etc., upon the length of time elapsing between starting to fill the room and starting to empty it. As far as the engineer is concerned, this method of designation is indeterminate; he needs to consider the lapse of time between completion of the filling of the room and the readiness to be emptied. Fig. 3 gives the minimum quantities of air required per ton of fruit to cool the fruit in the number of hours indicated from the time the last box is in place until the fruit has all reached the shipping temperature. To these quantities must be added sufficient air to offset the maximum wall losses during the latter part of the cooling cycle. The quantities are based upon 28F entering air and an initial fruit temperature of 80F.

Precooling is usually accomplished by recirculated air through an air washer or wetted surface cooler. Dry surface coolers would be usable but for the mechanical difficulty due to frost and the slight loss of efficiency due to the lower specific heat of dry air. High humidities are not necessary because the fruit is wrapped and the rate of evaporation is a function of the dry bulb temperature rather than of the dewpoint. Attempts have been made to provide higher humidities by means of water atomizers in the rooms but it is almost impossible to eliminate dripping, which is a disadvantage in a precooler.

Conditioning of Lemons

Lemon storage rooms are of all sizes from 200 to 20,000 tons capacity per undivided space, and of all shapes. They are insulated and are kept reasonably air-tight. When refrigerated, they are usually maintained at a constant temperature of 57F and 85 to 88% relative humidity and are ventilated to keep the CO_2 down below ½%. The fruit, like oranges, come from the washers and driers at about 80F but are loose in storage boxes at 60 lb. per box; and the quantity added and extracted per day is a very small per cent of the total storage capacity. At present it seems that the preferred system for these rooms is to supply sufficient air, saturated at the required dewpoint in the room, to remove all the heat. Slightly less popular is the method based on introduction of drier air and adding to the humidity by means of water atomizers in the room. The disadvantages of the latter method are drippage and maintenance but the actual choice is usually determined by the relative first costs. The necessary amount of fresh air for ventilating must be provided but it is often stipulated that during the hours of most extreme heat the CO_2 may be permitted to rise to 1%. A rise of 2F in room temperature upon an extreme day is not detrimental if the heat thus gained can be removed promptly at night. Dry surface coolers would be usable if suitable provision can be made to replace the moisture lost by condensation on the coils.

The fidelity with which some packers cling to the effort to save lemons solely with the aid of nature is a paradox. Their faith is more nearly justified near the coast especially toward the north where the fruit seems to be harder to damage and the night breezes from the ocean are inclined to carry more humidity. It is customary in these places to close the rooms tightly during the daytime and open them up as widely as possible at night. This leaves entirely to chance the question of nighttime temperatures and wind velocities

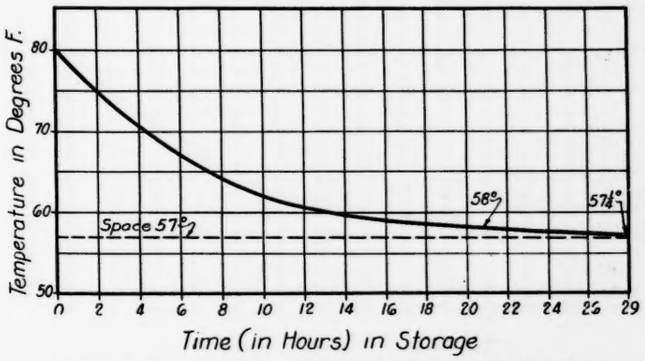


Fig. 5. Temperature changes of lemons in storage.

to remove the accumulation of each day's heat as well as sufficiently high humidities at all times to prevent excessive drying. In some places, blowers are used to reinforce the wind and in others air washers are used to help with lower temperatures and higher humidities. In such plants as these, 65F fruit is considered fair results but the temperatures often creep up to 70F and even 75F, in a series of hot days, and can not be reduced much thereafter during that particular storage season. Owing to the high specific heat of citrus fruit, a ton of it only 8F above its optimum temperature contains as much excess heat as 100 lb. of ice.

The practices in handling citrus fruit have progressed from the status of let-come-what-will to a high degree of modern precision within very few years; and the transition is far from complete. The business of air conditioning for citrus fruit is certain to be even more important in the future than it is at present.

Estimating Coal Consumption

THE chart shown in Fig. 1 furnishes a short cut method of estimating the number of tons of coal which a loft, office or apartment building will use during the average year. It was drawn up by I. R. Hoffman, Fuel Engineer, Central Coal Company, for use in determining fuel consumption of buildings in the New York area. It should be noted here that the chart applies only to the New York area.

The chart was designed for use with anthracite coal averaging 13,000 B.t.u. per lb. It was assumed that offices and lofts have 12 hours of service a day while apartments have 16 hours. The ordinate of the graph is ruled to indicate the gross cube of the building to be heated while the abscissa shows the tons of coal used in the average heating season.

The small figure in the lower right-hand corner shows how fuel consumption varies for each month.

In order to use this method it is necessary to first determine the gross volume of the building in cubic feet and the per cent of exposure of the building surface.

Then a horizontal line is drawn from the gross cube to intersect with the proper building line. From this point a vertical line is drawn to the top and continued at the proper angle to the per cent exposure line. From this point a vertical line is dropped to the abscissa and the tons of coal read.

The amount of coal used during the various months of the heating season is obtained by the use of the small graph. This graph shows that in New York 5% of the yearly coal consumption will be used in October, 12% in November, 19% in December and so on. This chart is based on a 65 year degree-day average.

Suppose that we have a loft building which has a gross cube of 1,600,000 with a 25% exposure. What is the yearly fuel consumption during the average year and what is the fuel consumption during an average December?

On the chart draw a horizontal line along the 1,600,000 gross cube line until it intersects with the loft and office heat line. From this point erect a vertical line to the top horizontal line. From here draw a line at an angle up to the 25% exposure line. From this point drop a vertical line down to the abscissa and read the tons of coal used in an average year. This figure is 340 tons per year. The small chart in the lower right-hand corner shows that during the month of December we will use 19% of the total yearly consumption. 19% of 340 is approximately 65 tons. This will be the consumption during a normal December.

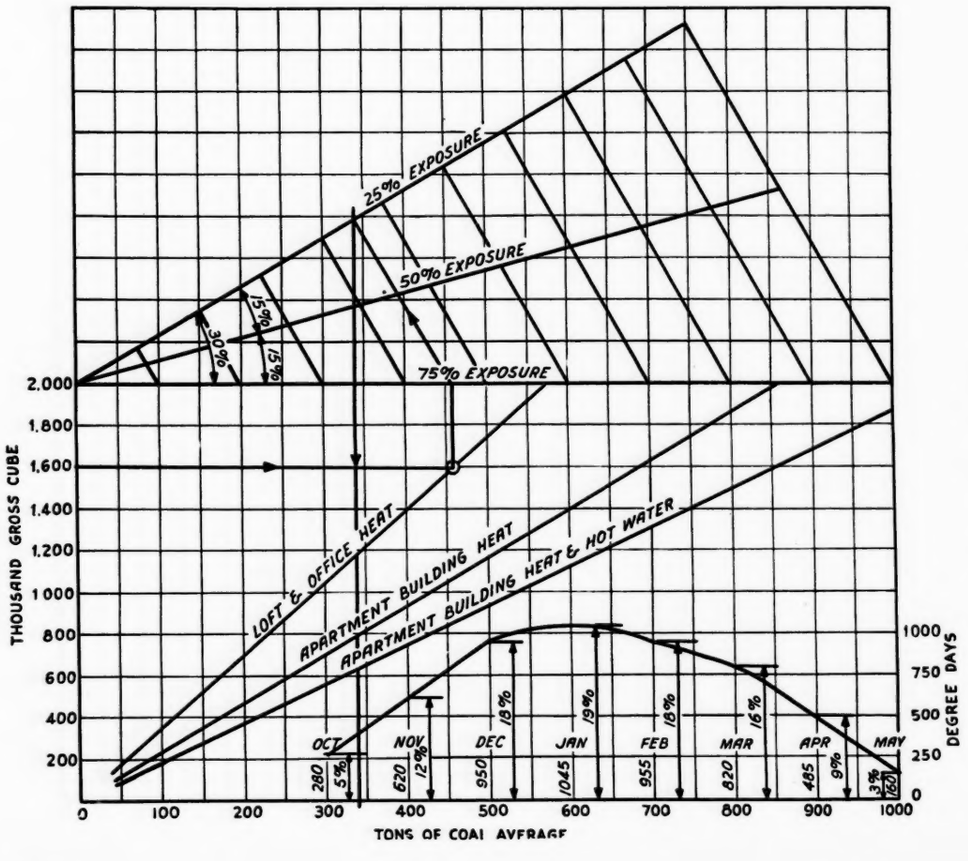


Fig. 1. Chart for estimating annual coal consumption.

ABSTRACTS of Current Papers, Books and Pamphlets

Principles of Ventilation and Heating

It is the author's purpose to present in this book a summary of current English views on ventilation and heating with particular reference to the psychological aspects. Most of the books on heating and ventilation deal with the technical developments and treat the basic principles only slightly. For this reason this book should appeal to men new to the heating and ventilating industry and to those who have not kept up with current literature. It should be noted here that the section dealing with comfort should not be applied literally since comfort standards in England differ considerably from those in the United States due to the differences in climate, clothing, and heating methods. However, the book as a whole serves as an excellent summary of the basic principles.

A list of the chapter headings follows: Historical Account of Ventilation and Heating; Modern Methods of Heating Buildings; Modern Methods of Ventilation; Warmth and Comfort; Causes of Discomfort; Stimulating Environments; Work at High Temperatures; The Influence of Atmospheric Conditions on Accident Frequency and Sickness.

[*"Modern Principles of Ventilation and Heating," by T. Bedford. Published by H. K. Lewis & Co. Ltd., 136 Gower St., London, W.C. 1, England. Cloth bound; 6 x 9 in.; 85 pages; price, 4s. 6d.*]

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Fuel Management for Schools

One of the most important items in the fuel budget is the item for the purchase of fuel. It is important that not only the most economical fuel be purchased but also that the most efficient means of converting the fuel into heat be employed.

Investigation made by the author revealed that while a few fundamental principles concerning fuels had been studied these dealt mainly with the purchase of fuel. As a result of this study the author decided to make an attempt to develop a complete school management program which will enable boards of education and administrative officers to conduct the schools in the most economical manner in regard to the management of fuel and yet maintain conditions that are conducive to efficient classroom procedure.

To get the necessary background for such a program the author has made a critical study of the fuel management program of eight selective cities of New Jersey and has compared his findings with a nationwide practice. The findings of this study, as well as a complete fuel management program for any school system, is incorporated in this book. The fuel management program is divided into three sections, the first dealing with fuel management from the source of supply to the furnace door, the second with fuel management from the furnace door to heat mains, and the third with the management from the heat mains out through the building and back to the boiler or heat retainer. Each section discusses in detail the method of improving the efficiency and gives, or shows where to obtain, the necessary information. A four-page bibliography on the heating of school buildings is included in the appendix.

[*"A Critical Analysis of the Fuel Management Program for Schools," by Ashley M. McCullough. Published by the Bureau of Publications, Teachers College, Columbia University, New York. Cloth bound; 6 x 9 in.; 141 pages; price, $1.85.*]

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Bibliography of Investigations on Coal

Nearly 2000 publications on the subject of coal have been prepared by engineers and chemists of the Bureau of Mines, Department of the Interior, since the organization of the Bureau in 1910. The various items in this extensive library of coal are described in this bibliography just issued by the Bureau.

The bibliography includes publications issued by the Bureau, those written by its staff for the technical press, and reports of work done jointly with states, colleges, and industries. References are given under 18 subject classifications; covering the occurrence, composition, properties, mining, preparation, and utilization by combustion, carbonization, gasification and liquefaction of coal. In addition there is included a complete index of subjects and an index of authors. Within each subject classification the papers are separated in groups based on the medium of publication and arranged in each group alphabetically by authors. Thus the user can find almost instantly all the publications of the Bureau on any subject related to coal.

[*"Bibliography of U. S. Bureau of Mines Investigations on Coal and Its Products, 1910-1935," Technical Paper 576, by A. C. Fieldner, Alden H. Emery, and M. W. von Bernewitz. Paper cover; 6 x 9 in.; 145 pages; for sale by the Superintendent of Documents, Washington, D. C.; price, 15c.*]

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BRIEF REVIEWS

WELL WATER. A study of the use of well water for air conditioning in the state of Illinois. The author finds that in the southern third of the state of Illinois it is extremely hard to find ground water at a suitable low temperature and in sufficient quantities for use as a cooling agent in air conditioning units for relatively large buildings, such as theaters, churches, and office buildings. Conditions are somewhat better in that portion of the central third of the state east of the Illinois River but west of the river the area is in the same general classification as the southern third. The opportunities for obtaining cold ground water are best in the northern third of the state. [*"Well Water Capacities Available for Air Conditioning," by Winfred D. Gerber; Journal of the American Water Works Association, 29 W. 39th St., New York; June, 1937; pages 832 to 835.*]

EFFECT OF SMOKE ON HEALTH. A study of the direct effect of inhaling smoke from the burning of anthracite, coke and bituminous coal. The primary object of this study was the determination of the maximum physiological and pathological effects of the mixtures of flue gases supplied to experimental animals under specified conditions. The animals were subjected to almost continuous exposure, the concentration of flue gases in the mixtures was uniformly maintained, and periodic analyses of conditions in the chambers and effects of the artificial atmosphere on the experimental animals were made. [*"Effects of Inhalation of Smoke from Common Fuels," by Lucy Schnurer; published in the American Journal of Public Health, 50 W. 50th St., New York; October, 1937; pages 1010 to 1022; single copies, 50c.*]

COAL SELECTION. A review of the papers on coal burning presented at the Fuels Meeting of the ASME from the angle of the selection of bituminous coal for the various types of coal burning equipment. Paper also summarizes the characteristics of coal that are important in all types of combustion equipment and those that are distinctive to certain types. [*"Status of Our Knowledge of Coal Selection for Steam-Generating Equipment," by R. A. Sherman; published in "Mechanical Engineering," November 1937, 29 W. 39th St., New York.*]

COAL. A report on bituminous and Pennsylvania anthracite coal for the year of 1936. Gives, among other things, a review of the industry, production, labor statistics, and equipment and methods of preparation. This is a reprint of the chapter from the Minerals Yearbook 1937. [*"Coal," by F. G. Tryon, L. Mann, H. L. Bennit, W. H. Young, and J. R. Bradley. Published by the Bureau of Mines. Paper cover; 6 x 9 in.; 103 pages; available from the Superintendent of Documents, Washington, D. C.; price, 15c.*]

DIRECTORY OF NEW YORK STATE MANUFACTURERS. List of all (45,000) New York State manufacturers with a description of the products made, names of owners and executives, and the number of employes used in factory or plant. Also lists public utility plants and their chief officers, national state, savings banks and loan associations, alphabetical listing of all municipalities, population figures, fire insurance ratings, property valuation, tax rates, and other data of value to companies doing business in New York State. There are three maps showing gas and electric utilities, canals and waterways and railroad facilities. Prepared in cooperation with New York State Department of Labor. [*"Directory of New York State Manufacturers," published by The Journal of Commerce, 63 Park Row, New York; price, $10.*]

CHIMNEYS AND FIREPLACES. A booklet to give the householder and prospective builder a working knowledge of the principles to be observed in planning and building chimneys and fireplaces. This bulletin is a revision of and supersedes Farmers' Bulletin 1230, Chimneys and Fireplaces. [*"Construction of Chimneys and Fireplaces," Farmers' Bulletin No. 1649, U. S. Department of Agriculture. Paper cover; 6 x 9 in.; 17 pages; for sale by the Superintendent of Documents, Washington, D. C.; price, 5c.*]

COKE. A review of coke and byproducts for the year of 1936. Gives statistics of the coke industry. A reprint of a chapter from the Minerals Yearbook 1937. [*"Coke and Byproducts," by W. H. Young, H. L. Bennit, and M. Otero. Published by the Bureau of Mines. Paper cover; 6 x 9 in.; 45 pages; for sale by the Superintendent of Documents, Washington, D. C.; price, 10c.*]

STEAM-HEATING SPECIFICATIONS. Specifications for radiator valves of both air and thermostatic type for gravity steam-heating systems, to become effective not later than December 1, 1937. [*"Federal Specification for Valves, Radiator; Air, Thermostatic (Gravity Steam-Heating Systems)," WW-V-151. Loose-leaf; 5 x 7¾ in.; 6 pages; for sale by Superintendent of Documents, Washington, D. C.; price, 5c.*]

ATMOSPHERIC COOLING TOWERS. A discussion of problems arising in the designing of cooling towers, the losses accompanying their operation, and the relationship between tower size, capacity, and temperature range. [*"Operation of Atmospheric Water Cooling Towers," by G. R. Nance and H. A. Dresser; published in the Oil and Gas Journal, Tulsa, Okla., July 29, 1937, pages 82 to 86.*]

BURNING CHEMICALLY TREATED COAL. A study of the effect of treating coal and coke with small quantities of chemicals with the object of increasing the efficiency of combustion. [*"Burning of Coal and Coke Treated with Small Quantities of Chemicals," by P. Nicholls, W. E. Rice, B. A. Landry and W. T. Reid. Bulletin 404, Bureau of Mines. Heavy paper cover; 6 x 9 in.; 158 pages; for sale by the Superintendent of Documents, Washington, D. C.; price, 15c.*]

FARM BUILDING VENTILATION. A discussion of electrical ventilation of livestock structures. Presents information on selection of equipment, installation procedure, location of fans and intakes, and cost of operation. [*"Electrical Ventilation for Livestock Structures," by C. H. Jefferson and D. G. Ebinger; published in The Quarterly Bulletin, Agricultural Experiment Station, Michigan State College, East Lansing, Mich. Volume 19, No. 2, November 1936. Address application for copies to V. R. Gardner, Director.*]

PIPE FRICTION. A study of diversion losses in pipe bends from tests of special conduit bends designed for lower fluid losses. [*"Diversion Losses in Pipe Bends," by Ellery R. Fosdick. Engineering Bulletin No. 51, Engineering Experiment Station, State College of Washington, Pullman, Wash.; paper cover; 6 x 9 in.; 24 pages.*]

STEAM BOILERS. A second edition of this well known book on steam boilers written for the practical man. Contains over 160 pages of new text and 144 new illustrations. The section on modern types of boilers has been entirely rewritten and material has been added on steam dryers, steam washers, water wheels, and superheaters. New text has also been prepared on stokers, pulverized coal, oil burning, boiler settings, furnaces, economizers, fans and feed water equipment. [*"Steam Boilers," by Terrell Croft, revised by R. B. Purdy. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York. Cloth bound; 5½ x 8 in.; 417 pages; price, $4.*]

EDITORIALS

Degree-Hours for Comparisons

With this issue comparative figures are available for the first time showing on a uniform base the extent of the high temperature periods in any sizable number of important cities. The summer degree-hours for 1937 and 1936 for 30 of the larger cities are presented on page 74. We believe that these figures are worthy of serious attention, for among other points they show that the 1937 season was much less severe generally than was that of 1936—a record breaker in many places.

Even a casual scanning of the figures will also show many other points of interest. For example, Kansas City retains its distinction of having the highest total number of degree-hours—a distinction rarely yielded so far as existing records reveal. St. Louis, which soared to second place in 1936, experienced less than 30% as high a total as a year ago. Houston, around the middle of the list in 1936, surged into second place in 1937. Des Moines, which is frequently up near the top, reported a total only about 40% of that for 1936. Cities as widely separated as Detroit, Fort Wayne, New York, Pittsburgh, and Toledo all show totals approximately the same for 1937, but it takes only a glance to note that this state of affairs does not occur every year. At the low end of the scale it is interesting to note that San Diego and San Francisco show negligible totals both years while Buffalo also has but few hours per season when the dry bulb temperature exceeds 85F. It will quite possibly surprise many to note that St. Louis, Bismarck, Cincinnati, and even Minneapolis frequently show totals comparable with those of southern cities like Birmingham and Savannah.

All this information can not yet be fully evaluated but even now it is apparent that there is significance in these figures. No extraordinary sales of summer equipment have been reported from the cities low on the list of total degree-hours while, on the other hand, in the cities where the degree-hours are consistently high, interest in summer cooling has been greatest.

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New Medical Interest in Air and Heat

For a long period those engaged in designing and constructing heating and ventilating equipment and plants have bemoaned the lack of interest displayed in these subjects by physicians and medical men generally. To us it seemed that the medical and public health groups should state the objectives in measurable terms which the equipment men could understand and apply.

It is also pretty evident from the record that the medical groups generally were little interested. They seemed convinced that the effects were of little practical importance; they had other much more absorbing problems, and they were not blessed with any surplus of either funds or facilities for conducting studies.

Within the past few years there is growing evidence that this condition of affairs is rapidly changing for the better. Now there are several specially equipped experimental laboratories for studying certain of the effects of heat and air on health, as well as a considerable number of hospital installations of air conditioning for various purposes. The laboratories are busy with programs looking toward establishing limits of application and securing a knowledge of the fundamentals while the hospital installations are being operated with care and serve as places where the results can be observed with patients receiving actual hospital attention. The American Medical Association and the American Public Health Association have both given recognition to this new interest by including air conditioning on their meeting programs during 1937. Already some of the results from laboratories and from hospitals are being published and statements of the desirable conditions to be maintained are appearing in terms of definite temperatures and humidities. This new attitude toward heat and air is one of the really promising developments of recent years.

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Fundamentals in the Insulation Problem

The problem of moisture in the heat insulating materials used in building construction is one which needs to have the facts concerning it better understood generally. Every so often we receive letters in which the writer states that since his insulating material is water resistant it is impossible to have moisture problems where it is used. For anyone who is actively engaged in promoting the use of a particular insulating material to hold such views is really deplorable, even making due allowances for a man being oversold on his own product. Whatever else the problem may involve in practice, it takes no great amount of thought to perceive that moisture absorption is not the decisive factor. The important points are that liquid water will freeze at air temperatures below 32, and that water vapor will condense at temperatures below the dewpoint. So far as known these phenomena take place quite regardless of the material on which or in which the moisture may lie. The fact that water is lying on the surface or in the pores of a solid substance, or in the air spaces between the fibers of an insulator, makes no difference to the water for it will condense and freeze regardless when the governing temperatures are reached. This does not mean that it is not a good idea to use moisture-resistant materials for heat insulators. There is ample reason to conclude that the property of repelling moisture is desirable in such materials but the mere fact that they possess this property is not insurance that there will be no moisture problem in practice. With heat insulating materials having been used for so long a period it is rather surprising that at least the basic information about how moisture problems arise in connection with them is not more widely held and better understood. It has been repeatedly published and discussed and all heating engineers, virtually every one of whom has the problem called to his attention at some time, should make it their business to know these essentials.

NEWS OF THE MONTH

14 Technical Papers Listed for 44th ASHVE Annual Meeting; 40,000 Expected to View 250 Exhibits at Exposition

NEW YORK—The eyes of all who are interested in heating, ventilating and air conditioning will be focussed on New York during the week of January 24, when the 44th annual meeting of the ASHVE will be held at the Hotel Biltmore and the 5th International Heating and Ventilating Exposition will be housed in Grand Central Palace. Simultaneously the annual meeting of the ASRE and the midwinter meeting of the National Warm Air Heating and Air Conditioning Association will be held in the Hotel Roosevelt.

At the society's technical sessions, which begin on January 25, papers of widespread interest to society members will provide the opportunity for technical discussion. The program below shows some of the subjects to be presented at the technical sessions.

Joint sessions with the ASRE and the National Warm Air Heating and Air Conditioning Association will be held during the week and the three organizations will participate jointly in some of the entertainment functions.

The ASHVE New York Chapter will act as host and the following committee on arrangements has been appointed: A. C. Buensod, chairman; Alfred Engle, vice-chairman; Reception—W. W. Timmis; Banquet—Russell Donnelly; Finance—F. E. W. Beebe; Ladies—H. W. Fiedler; Publicity—C. H. B. Hotchkiss; Entertainment—G. E. Olsen; and Inspection Trips—A. J. Offner.

The 5th International Heating and Ventilating Exposition has already attracted 300 exhibitors and it is estimated that 40,000 buyers of heating, ventilating and air conditioning equipment will visit this exposition to learn about the latest methods for commercial, industrial, and domestic service.

PROGRAM—44TH ANNUAL MEETING—ASHVE
HOTEL BILTMORE, NEW YORK

JANUARY 24

9:30 a.m.

Registration.

2 p.m.

Opening of Exposition.

6:30 p.m.

Get Acquainted Dinner (Bowman Room).

JANUARY 25

9:30 a.m.

Greetings, W. E. Heibel, president, New York chapter.

Response, President D. S. Boyden.

Application of District Heating to Steam Jet Refrigeration, A. R. Mumford and A. A. Markson.

2 p.m.

Joint Session with National Warm Air Heating and Air Conditioning Association.

Air Distribution from Side Wall Outlet, D. W. Nelson and D. J. Stewart.

7:30 p.m.

Night club party.

JANUARY 26

9:30 a.m.

Relation of Body Changes to Air Changes, Dr. R. W. Keeton.

Studies on Bacterial Control in Air Conditioning, T. S. Carswell, J. D. Fleming, and H. K. Nason.

Drop in Skin Temperature and Sense of Coolness with Various Air Conditions, F. C. Houghten.

2 p.m.

Joint Session with American Society of Refrigerating Engineers.

Control of Air Conditioning in Large, Medium, and Small Buildings, W. E. Zieber and S. F. Nichol.

Cooling Tower Equipment and its Relation to Water Conservation, S. I. Rottmayer.

Physiological Reactions and Sensations of Pleasantness Under Varying Atmospheric Conditions, Dr. C.-E. A. Winslow, L. P. Herrington, and A. P. Gagge.

JANUARY 27

9:30 a.m.

Comparative Analysis of Office Building Air Conditioning Systems, J. R. Hertzler.

Heating Effects of Artificial Lighting on Air Conditioning, Walter Sturrock.

Heating and Ventilating the Lincoln Vehicular Tunnel, C. W. Murdock.

2 p.m.

Inspection Trip to Lincoln Vehicular Tunnel.

7 p.m.

Annual Banquet.

JANUARY 28

9:30 p.m.

Study of Methods of Control and Types of Registers as Affecting Temperature Variations in the Research Residence, A. P. Kratz and S. Konzo.

Heat Transfer through Single and Double Glazed Steel Sash, M. L. Carr, R. A. Miller, A. C. Byers, and Leighton Orr.

Condensation of Moisture in Insulated Walls, F. B. Rowley, A. B. Algren, and C. E. Lund.

Comfort Zone Set at 83F to 90F, Doctors Report to Scientists

ROCHESTER, N. Y.—The unprotected human body is no more capable of insulating itself from the atmosphere than is a tank of warm water, according to Eugene F. DuBois, professor of medicine at Cornell University Medical College, and James D. Hardy, research fellow of the Russell Sage Institute of Pathology, who have proved the existence and defined the extent of a "warm zone," a "comfort zone," and a "cold zone" of temperature in each of which the body behaves differently. This information was contained in a paper presented by the authors before a meeting of the National Academy of Sciences here Oct. 27.

The paper stated that the tests were performed on two normal men to study the regulation of body heat loss when exposed nude to environments ranging from 72 to 96F.

It was reported also that an artificial man constructed out of a blackened cylindrical tank filled with circulating warm water lost exactly the same amount of heat as the men by radiation and convection.

Doctor DuBois described how the human subject of the experiment arrived in the laboratory at 9 a.m. without breakfast, undressed completely but slowly to avoid the generation of extra heat by exertion, and then entered the calorimeter, a large insulated box whose interior atmosphere could be altered at will from that of an icebox to that of a sweatbox.

After the large subject and another smaller man had taken their turns in the calorimeter, they combined their efforts to install in their place the artificial man.

The artificial man did nothing but radiate, but the two human occupants of the calorimeter sweat, shivered, and otherwise suffered. Thus they were able to add their own subjective experiences to the objective evidences of their instruments, charts and graphs, in reaching the following conclusions:

(1) The "warm zone" is above 90F. Here sweating begins and becomes uncomfortably profuse as the temperature goes up. The flow of blood to the skin, bringing heat and moisture to be eliminated as perspiration, may be five or six times the normal. Sometimes this cooling action is inadequate; an athlete may develop a temperature of 103F during heavy exercise.

(2) The "comfort zone" is between 83 and 90F. Here, without either sweating or shivering, the blood easily eliminates heat as fast as it is generated in the body, and the mind, untroubled by the necessity of doing anything about temperature regulation, is at rest.

(3) The "cold zone" is below 83F. At 83F the blood flow to the skin has throttled down to a minimum and can reduce itself no farther. There is no other mechanism of the body to reduce the heat leakage.

All that the body can then do to keep its temperature up is to generate more heat compensating for the constant drain. This it does by shivering.

Doctor Hardy remarked that nature seemed to have provided better for the warm zone than for the cold zone, since it gave man the power of perspiration to remove excess heat but gave him no protection against excess cold.

A. S. Armagnac Joins Art Magazine

NEW YORK—Arthur S. Armagnac, formerly editor and co-publisher of HEATING & VENTILATING, has been appointed business manager of *Art Instruction*, a publication for students of art. The magazine is published by Watson-Guptill Publications, Inc., 330 West 42nd St., New York.

Mr. Armagnac, together with Gustave Petersen, published HEATING & VENTILATING for almost a quarter of a century. They disposed of their interests in 1928.

Boost Oil Prices in Philadelphia

NEW YORK—Standard Oil Company of New Jersey announced on November 1 an increase of ¼c. per gal. on spot deliveries at Philadelphia of medium, heavy, and diesel fuel oils.

Chicago Adds 7 Conditioning Jobs

CHICAGO—Seven air conditioning lines were added to the Commonwealth Edison Company during October. Of these, five were central plant installations totaling 93 tons, while the other two were room coolers totaling 5½ tons, making a total of 98½ tons.

The largest single installation, 65 tons, was in the C. E. Auditorium.

Stoker Sales Break All Records

CHICAGO—All existing sales records for mechanical stokers were shattered in September when a total of 19,193 factory sales in that month were reported by 108 establishments. This is an increase of 42.5% over the previous month with 13,459 sales and 15% ahead of September a year ago with 16,638 sales.

Chicago A.C. Jobs Break Records

CHICAGO—Air conditioning contracts closed here during the first nine months of 1937 set a new high record both in number and capacity, according to the Commonwealth Edison Company. Contracts for 549 installations were made, compared with 398 during the first nine months of 1936, an increase of 38%. Capacity aggregated 11,367 hp., compared with 7099, 60% over last year.

A total of 291 electric room cooler units was contracted for during the nine months, against 184 a year ago, an increase of 58%.

Thorburn Appeals for Cooperation Between Engineers and Doctors

NEW YORK—Cooperation between the air conditioning engineer and the medical profession was stressed in an address by Dr. Thomas R. Thorburn, D.O., M.D., assistant surgeon of the New York Ophthalmic Hospital and head of the nose, throat and ear department of the New York Osteopathic Clinic, before the November 15 meeting of the ASHVE New York Chapter, on "What Patients Tell Their Doctors About Air Conditioning."

Dr. T. R. Thorburn

Emphasizing the point that the engineering profession is every year being more closely linked with the medical profession, Doctor Thorburn indicated the need for closer understanding between those engaged in the art of air conditioning and those in the healing arts. Air conditioning practice, he said, has established certain standard atmospheric conditions to which the public must be adapted in order to extract the greatest benefits, and this requires a vast amount of educational work, both on the part of the doctor and the engineer.

The speaker also gave his views regarding the importance of shock between indoor and outdoor temperature during winter months which, in his opinion, was of greater significance to health than the cold shock experienced when entering a cooled space in the summer. Doctor Thorburn saw air conditioning in a position to wield an influence upon dress and diet. He stated as an example of the latter an inclination to eat more and heavier foods in air conditioned restaurants in summer, because of the desirable comfort conditions, but pointed out that this often accentuates the feeling of discomfort when emerging from such conditioned places because metabolism was increased and the body less able to quickly adapt itself to a change of atmospheric conditions.

After an air conditioning system is installed, intelligence in its operation is of prime importance, according to the speaker, and is largely responsible for favorable reaction to air conditioning by the public. Doctor Thorburn made a special plea for education along the lines of teaching the public to realize that most complaints of harmful effects from air conditioning come from persons suffering from some uncertain physical deficiency or surrounded by a harmful psychological environment. The average normal person is perfectly immune from such effects, he concluded.

Byrd Elected President of Bureau

CHICAGO—A new slide film "Capturing Public Attention," dramatizing the publicity activities of the Plumbing and Heating Industries Bureau, was shown at the annual meeting of the Bureau here October 27.

A. C. Brown, chairman of the 1937 finance committee, reported that 37 associations contributed over $17,000 during the year to the Bureau, 42% over the 1936 amount.

Wm. M. Byrd, Jr., vice-president of the Alabama Pipe Company, was elected president of the Bureau. George E. Hoffman, manager of the plumbing and heating sales department of Crane Company, was elected vice-president. Charles K. Foster, executive vice-president of the American Radiator Company, was re-elected treasurer.

Boston Adds 68 Hp. in 5 A.C. Jobs

BOSTON—Five air conditioning installations were reported in this territory by the Boston Edison Company during October. One was a 36¼-hp. theater job; another a 22-hp. restaurant cooling system. The horsepower capacity added during the month totalled 68.

A.C. Jobs in 1937 Total $85 Million; Up 60% Over 1936 Business

CHICAGO—Growing importance of the scarcely-touched field of residential air conditioning, continued expansion of major installations in many lines of trade and industry, and emphasis on long-range planning for the future of the organization high-lighted the annual fall meeting of the Air Conditioning Manufacturers' Association.

Installed cost of equipment sold by the ACMA members, it was declared, will approximate $85 million for 1937 as compared to $53 million last year.

The advertising committee of ACMA will continue to watch advertising which offers "air conditioning" equipment actually not meeting the definitions of the Better Business Bureau and the Air Conditioning Manufacturers' Association. Winter air conditioning must humidify, warm, and circulate the air. Summer equipment must dehumidify, cool, and circulate the air, which also preferably must be cleansed at all times.

Comfort, economy, and health were advanced as leading sales appeals for air conditioning. Another factor was cited by P. Y. Danley, manager of the Westinghouse refrigeration and air conditioning department.

"We think that a fictitious figure has been set up in the mind of the public regarding the cost of air conditioning and that it is nowhere near as expensive as the majority believe," Mr. Danley said.

In merchandising residential air conditioning as a packaged unit, Mr. Danley said, Westinghouse will concentrate upon the market comprising new homes, costing from $5000 up. These units, he said, will cost no more than the price of a good heating system, and for the average house, no more than a medium-priced automobile.

J. J. Donovan, manager of the air conditioning department of General Electric Company, advanced the belief that health is the actual primary appeal of air conditioning although comfort and economy have been most eloquent themes in copy aimed at the general public and business men, respectively.

British Strike for Better Heating

LONDON—Agitation against poor heating systems in British factories appears to be a chief cause of industrial discontent in the United Kingdom. This discontent, which has been growing for some years, breaks out with renewed vigor each winter. While much has been done lately to improve conditions, much more will have to be done before winter working conditions are raised to a generally healthy and satisfactory state throughout the country.

Recently 500 employes of the aircraft works of the Austin Motor Co., Birmingham, went on strike due to unsatisfactory heating. The new heating installation in the largest section of the works and air frame shop is not yet complete, and the workers state that during cold weather they will not work unless the building is adequately heated.

1938 Building Volume to Equal 1937

NEW YORK—Privately financed building and engineering work in 1938 should approximate the same volume as in 1937, according to Thomas S. Holden, vice-president of F. W. Dodge Corporation, in a statement on the construction outlook. However, publicly financed work is likely to continue its decline, resulting in a moderately reduced total volume of construction next year.

The Dodge estimates indicate that 210,000 to 220,000 new family dwelling units are likely to be built in the entire country next year, compared with an estimated 185,000 to 195,000 in 1937, and 160,000 in 1936. This moderate increase in residential building is likely to be accompanied by a volume of commercial building approximately the same as this year's, and declining volume of factories and public and institutional buildings. While combined moderate increases in residential building and moderate decreases in non-residential building would give a total building volume about equal that of 1937, heavy engineering work is also likely to decline somewhat, resulting in a net decrease in the total volume.

DeLuxe Trailer Has Cooling Unit

NEW YORK—For the first time in the history of the automobile show here trailers equipped with a complete, portable air conditioning unit were shown at Grand Central Palace.

The Curtiss Aerocar Co., Coral Gables, Fla., is said to be the first trailer company to install conditioning units in its models, one of which was on exhibit at the show. The trailer was equipped with a 1/3-ton compressor. Both the air conditioning unit and the electric refrigerator may be operated while the trailer is on the highway by means of an 850 watt capacity, 110 volt a.c. motor-driven generator installed in the power unit.

The unit cools, dehumidifies, deodorizes, washes, and circulates 300 c.f.m.

Building Trades Work 40.2-Hr. Week

WASHINGTON—The recent survey of labor in the building trades conducted by the Bureau of Labor Statistics of the Department of Labor, showed that the average full time week in the building trades is 40.2 hr. Although the average for all building trades workers combined showed few significant regional differences, there were marked variations between occupational groups and between cities, the survey showed.

For 18.4% of the building trades employes covered by the Bureau survey, the weekly hours were over 40 hr., while 70.7% had a working week of 40 hr., and 10.9% a working week of less than 40 hr.

The differences in weekly hours among those building trades in which heating and ventilating contractors are concerned are shown in the accompanying table in which the figures are in per cent of the total. It will be seen that union steamfitters' helpers on the whole have the shortest working week of the group; 11½% of non-union sheet metal workers on the other hand worked over 48 hr. a week.

DISTRIBUTION IN PER CENT OF UNION AND NON-UNION STEAMFITTERS AND SHEET METAL WORKERS BY WEEKLY HOURS WORKED

Occupation	40 Hr. and Under		41 to 48 Hr.		Over 48 Hr.	
	Union	Non-Union	Union	Non-Union	Union	Non-Union
Steamfitters	96.7%	48.4%	3.3%	47.9%	—%	3.7%
Helpers	98.4	61.8	1.6	33.5	—	4.7
Sheet Metal Workers	95.5	39.2	4.5	49.3	—	11.5
Helpers	92.9	50.9	7.1	42.3	—	6.8
Plumbers	93.3	35.5	6.7	63.9	—	0.6
Helpers	96.9	49.0	3.0	50.3	0.1	0.7

Drying and Air Conditioning Papers Scheduled at U. of P. Symposium

PHILADELPHIA—Eleven technical papers on drying and air conditioning, and a round table discussion of drying equipment participated in by manufacturers' representatives of nine different types of dryers, are the principal features of the Fourth Chemical Engineering Symposium of the Division of Industrial and Engineering Chemistry, to be held here at the University of Pennsylvania December 27-28. This symposium follows symposia on distillation, heat transmission, and absorption and extraction, held in December of three previous years.

The program will open with a paper discussing the fundamentals of drying and air conditioning, to provide a theoretical background for the technical papers which follow. There will be several papers reporting research on the mechanism of evaporation of water into air, a description of an equilibrium pressure chart, and a method for the accurate determination of dew-point. Drying agents will be discussed in papers on drying with activated alumina, and with lithium chloride. Papers will be presented on vacuum drying, and on spray drying. The round table discussion of drying equipment will deal with rotary dryers, rotary louver dryers, steam tube dryers, spray dryers, vertical turbo dryers, crystal filter dryers, drum dryers, aeroform dryers, and agitator dryers.

Social features of the meeting will be group luncheons on both days, and a dinner program on December 27. The principal feature of this evening program will be a talk on "Research and Development in Television" by an authority in this field. Local arrangements are under the direction of Prof. N. W. Krase, of the University of Pennsylvania.

Abstracts of the papers to be presented will be mailed to all members of the Division of Industrial and Engineering Chemistry prior to the meeting. Those interested in membership in the Division should communicate with Howard S. Gardner, secretary, M.I.T. Field Station, c/o Eastern Mfg. Co., Bangor, Me.

Smoke Nuisance Spreads Disease, Murphy Declares at Meeting

HOBOKEN, N. J.—Speaking on "Air Pollution and its Relation to Community Health," before the Hudson County Smoke Abatement Association at Stevens Institute of Technology November 18, H. C. Murphy, American Air Filter Company, Inc., and chairman of the committee on air cleaning of the ASHVE, declared that the smoke nuisance in large cities is a contributing factor in the spread of disease from air borne bacteria held in suspension on smoke and dust particles.

"We are jeopardizing both the health of our citizens and the productivity of our countrysides by disregarding even our present half-hearted smoke abatement laws," Mr. Murphy said. "Winter health conditions in our larger cities are getting steadily worse. We are paying the price for industrialism running wild. The dust which infects our cities is becoming daily more objectionable and more distinctly a menace to life."

Describing recent research at the Harvard School of Public Health indicating that germ-carrying droplets ejected when people cough, sneeze or talk remain in suspension for days, Mr. Murphy said that the latest study of air-borne bacteria was leading scientists to think that certain respiratory disease germs were becoming adapted to air transmission.

He traced the relationship between atmospheric pollution and decreased sunlight in large industrial centers, citing 10 large cities which, in a period of 10 years, according to U. S. Weather Bureau reports, suffered an average decrease in sunshine of from 6% to 17% during the winter months. The five American cities recording the largest average number of dust particles per cubic foot of air are St. Louis, Cincinnati, Pittsburgh, Detroit, and Chicago.

1936 Fuel Oil Sales Up 29% Over 1935, Bureau of Mines Reports; Middle Atlantic States Take 40% of U.S. Total

WASHINGTON—Heating oil sales in 1936 were 29% above those in 1935 and set a new high record, according to the Petroleum Economies Division of the Bureau of Mines. The demand for this fuel totaled 99,257,000 barrels, not including range oil sales.

An attempt was made for the first time in 1936 to divide the light and heavy heating oils into separate items. This was done at the request of the petroleum industry in order that more factual data could be assembled to show how much of the heating oil demand is supplied from the gas-oil-distillate fuel oil group. Reports giving the distribution of annual fuel oil sales are usually submitted to the Bureau of Mines by the marketing departments of the various oil companies; and for this reason nomenclature familiar to that branch of the industry was adopted in place of the terms "gas oil" and "distillate fuel oils" used by the manufacturing or refining divisions. The consensus of opinion indicated that the marketing Grades 1 to 4 usually designated the heating oils coming within the gas oil-distillate fuel oil range and that Grades 5 and 6 covered the heavy or residual fuel oils. Consequently, the oil companies were requested to report their heating oil sales under these two general headings. A tabulation of the incoming statements shows that light or distillate fuel oils designated by Grades 1 to 4 for the purposes of this survey totaled 69,429,000 barrels, or 69.9% of the 1936 heating oil sales, and that Grades 5 and 6 were used for heating to the extent of 29,828,000 barrels, or 30.1% of the total demand. The total for Grades 1 to 4 approximates the 1936 demand for domestic heating oils and the commercial heating requirements are indicated by the total for Grades 5 and 6, although it must be noted that the lighter grades of fuel oils are used for commercial heating in some installations and that heavy or residual grades may be used for residential heating, to a limited extent.

A regional breakdown of the 1936 heating oil sales indicates that the Middle Atlantic states constitute the most important market

SALES OF HEATING OILS BY STATES, 1934-1936
(Thousands of Barrels of 42 Gal.)

State	1936			Per Cent of U. S. Total for 1936
	Grades 1-4	Grades 5-6	Total	
California	717	2,872	3,589	3.6
Oregon	385	716	1,101	1.1
Washington	621	1,152	1,773	1.8
Arizona	9	40	49	—
Nevada	4	17	21	—
Idaho	12	5	17	—
Montana	67	23	90	0.1
Wyoming	45	2	47	—
Utah	22	7	29	—
Colorado	139	35	174	0.2
New Mexico	31	12	43	—
North Dakota	210	33	243	0.2
South Dakota	273	43	316	0.3
Minnesota	2,803	636	3,439	3.5
Nebraska	907	244	1,151	1.2
Iowa	936	271	1,207	1.2
Wisconsin	2,397	720	3,117	3.1
Illinois	8,084	3,421	11,505	11.6
Indiana	976	511	1,487	1.5
Michigan	2,343	880	3,223	3.3
Ohio	865	129	994	1.0
Kentucky	132	92	224	0.2
Tennessee	109	—	109	0.1
Missouri	3,180	1,347	4,527	4.6
Kansas	230	155	385	0.4
Texas	438	258	696	0.7
Oklahoma	220	101	321	0.3
Arkansas	192	2	194	0.2
Louisiana	259	145	404	0.4
Mississippi	42	18	60	0.1
Alabama	34	13	47	—
Maine	618	213	831	0.8
New Hampshire	785	148	933	0.9
Vermont	360	25	385	0.4
Massachusetts	6,470	2,959	9,429	9.5
Rhode Island	1,387	492	1,879	1.9
Connecticut	3,278	771	4,049	4.1
New York	15,223	5,442	20,665	20.8
New Jersey	6,802	1,908	8,710	8.8
Pennsylvania	3,961	2,459	6,420	6.5
Delaware	261	16	277	0.3
Maryland	1,099	454	1,553	1.6
District of Columbia	894	437	1,331	1.4
Virginia	647	158	805	0.8
West Virginia	46	5	51	0.1
North Carolina	220	28	248	0.3
South Carolina	103	11	114	0.1
Georgia	154	38	192	0.2
Florida	439	364	803	0.8
Total United States	69,429	29,828	99,257	100.0

REGIONAL DISTRIBUTION OF HEATING-OIL SALES, 1934-1936
(Thousands of Barrels of 42 Gal.)

Region	1934	1935	1936	Per Cent of Increase in 1936 Over 1935
Pacific Coast	4,347	5,586	6,533	16.8
Rocky Mountain	246	319	400	25.4
North Central	16,324	19,730	27,015	36.9
South Central	4,180	5,260	6,634	26.1
New England	10,793	14,040	17,506	24.7
Middle Atlantic	23,497	30,279	38,956	28.7
South Atlantic	1,435	1,639	2,213	35.0
Total United States	60,822	76,853	99,257	29.1

for heating oils and that this area accounted for nearly 39,000,000 barrels, or 39.3% of the 1936 total. The 1936 deliveries in this region represent a gain of 28.7% over the 1935 sales of 30,279,000 barrels, a quantity 39.4% of the national demand. The North Central group of states, wherein are located a number of important urban centers of population, such as Chicago, Detroit, St. Louis, Minneapolis, and Kansas City, ranks second as a consuming area for heating oils. Sales of heating oils in these states increased from 19,730,000 barrels in 1935 to 27,015,000 barrels in 1936. The latter total is 27.2% of all heating oil sales for the year, compared with 25.7% in 1935.

The New England states stand third as a market for heating oils, requiring 17,506,000 barrels in 1936, compared with 14,040,000 barrels in 1935. The remaining regions, South Central, Pacific Coast, South Atlantic, and Rocky Mountain are of less importance as consuming areas for heating oils. It should be noted, however, that the South Central states became the fourth most important market for heating oils in 1936, supplanting the Pacific Coast area for the first time.

Wallace to Head Crane Research

Chicago—Formation of a division of engineering and research by Crane Co., with L. W. Wallace, head of engineering research for the Association of American Railroads, as director, effective December 1, is announced by Charles B. Nolte, president of Crane Co. The new Crane division will comprise the existing division of research and development and the product engineering department of the company.

Mr. Wallace, who will be directly responsible to President Nolte, will direct the originating of new lines of products, the development of inventions and patents and the maintenance and improvement of existing Crane products.

Mr. Wallace has been director of engineering research for the Association of American Railroads for the past three years. During this time he built up an engineering research organization which performed important work in the fields of air conditioning of passenger cars, lightweight freight car construction, Diesel electric train operation and many phases of locomotive design and construction including a proposed steam turbine, direct drive, condensing locomotive. As a consulting engineer, he has conducted extensive research for railroads.

A graduate of Agricultural and Mechanical College of Texas, he was a member of the faculty at Purdue University for 11 years. Some years ago, he was assistant general manager in charge of production of the Diamond Chain and Manufacturing Co., Indianapolis. He then was executive secretary of the American Engineering Council for 13 years. In the latter position he was largely instrumental in organizing and directing many studies of industrial and engineering conditions of far-reaching influence.

Boston Now Has 327 A.C. Systems

Boston—On November 1, according to the Boston Edison Company, air conditioning installations in that company's territory totaled 327, aggregating 12,312 hp. Of these 268 are commercial installations, 43 residential, and 16 industrial. There were 20 residential installations added in 1937, with a total of 15 hp.

Plan Standardization of Motors

Detroit—The Industrial Unit Heater Association held a meeting here October 26 at which a joint report of the association and of a committee from the National Electrical Manufacturers Association was presented. The report covered the standardization of motors for propeller type unit heaters. It was accepted as a progress report only, inasmuch as some details need further ironing out.

WPA Spends Nearly Five Million for Heating Equipment and Supplies

Washington—Heating and ventilating equipment and supplies valued at $4,797,069 were among the nearly one-half billion dollars worth of materials, supplies and equipment purchased for projects of WPA in the first 26 months of its operation up until September 1, 1937, according to records of the WPA Division of Research, Statistics and Records.

Of this amount, $2,374,847 were in Federal funds from various emergency relief appropriations and $2,422,222 were in funds of the sponsors of projects. The greater part of the purchases were in small lots for individual projects, the bid awards usually going to dealers in the immediate vicinity of the projects.

Construction or repair accounted for 80% of the WPA activities, and purchase of materials, supplies and equipment for public buildings was second only in volume to such purchases for highways, roads and streets, so that the large aggregate buying of heating and ventilating equipment and supplies is not difficult to understand. Throughout the nation were instances where, at the beginning of the Works Program, activities normally conducted in public buildings would have ceased had it not been for the WPA projects which either supplied part of the materials and all the labor to install new heating and ventilating equipment or to repair equipment.

The purchases of heating and ventilating equipment and supplies were in addition to purchases in the Procurement Division category of plumbing equipment and supplies which amounted in value to $5,625,430. Of this amount, $2,305,519 were in Federal funds and $3,319,911 were in funds of the project sponsors.

Arco Introduces Heating System

New York—More than 200 members of the New York Building Congress attended a reception on October 19 given by the Congress in the recently opened showrooms of the American Radiator and Standard Sanitary Corporation here.

Arthur R. Herske, vice-president and general manager of sales of the American Radiator Company, speaking at the reception, declared that with the establishment of air conditioning, automatic heating, and other similar developments in home comfort, harvest time for building had arrived.

Shown at the reception for the first time anywhere was a new, experimental hot water heating system which utilizes noiseless, forced draft heating through the use of air turbine fans behind midget sized concealed radiators, with air to operate the fans delivered from a compressor in the basement through 5/8-in. copper tubing.

Introduced this month for limited sale by heating contractors in eastern metropolitan centers as a heating system, the new system points the way toward the possible development of completely ductless or piped air conditioning and comfort, Mr. Herske said.

In addition to the talk by Mr. Herske, brief talks were also made by Clyde R. Place, consulting engineer, and Ely Jacques Kahn, architect.

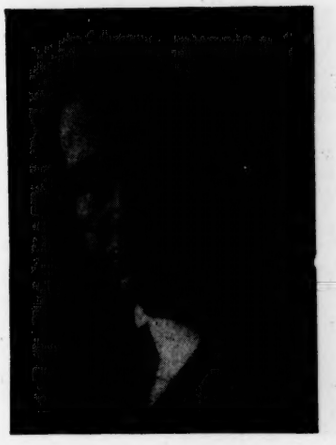
RMA Reelects Fernald and Baer

Chicago—J. M. Fernald, of Omaha, vice-president and general manager of the Baker Ice Machine Company, recently reelected president of the Refrigerating Machinery Association, has announced the continuation of a vigorous program of technical standardization work.

S. E. Lauer, vice-president, York Ice Machinery Corporation, was reappointed chairman of the standards committee at the meeting in Chicago. A. H. Baer, general sales manager of the Carbondale Division, Worthington Pump and Machinery Corporation, was reelected first vice-president, and William B. Henderson, Washington, D. C., was reengaged as executive vice-president.

D. R. Yarnall Honored by Engineers

Philadelphia—D. Robert Yarnall, chief engineer of the Yarnall-Waring Company of Philadelphia, has been elected president of United Engineering Trustees, joint agency of the four founder societies of electrical, civil, mining and metallurgical, and mechanical engineers.



D. Robert Yarnall

In 1912 Mr. Yarnall organized the Yarnall-Waring Company, manufacturer of heating and power plant specialties. He is a director and chairman of the public affairs committee of the American Engineering Council and vice-chairman of the Engineering Foundation.

Over 300 Exhibits are Scheduled for Heating and Ventilating Show

NEW YORK—Hundreds of operating exhibits will demonstrate man's conquest over the weather at the Fifth International Heating and Ventilating Exposition to be held at Grand Central Palace, New York, January 24-28. The Exposition will offer a comprehensive preview of the systems and equipment for winter heating, ventilating, and for air conditioning the year 'round. Occupying three entire floors of Grand Central Palace, more than 300 companies will exhibit their latest equipment including boilers, burners, warm air furnaces, stokers, vapor and hot water heating systems, pumps, fans, blowers, unit heaters, space heaters, district heating accessories, thermal insulation, instruments and control appliances, electrical equipment, air conditioning and refrigeration machinery.

The show is under the direction of Charles F. Roth, president of the International Exposition Company, who has directed all of the previous presentations. Permanent headquarters are at Grand Central Palace, New York.

During the week of the Exposition, the ASHVE, under whose auspices the Exposition is held, will hold its annual meeting in New York. Also meeting in New York during the same week will be the ASRE and the National Warm Air Heating and Air Conditioning Association.

Erickson Talks to Junior ASME

NEW YORK—"What the Air Conditioning Industry Expects From the Engineer" was the subject of the principal November meeting of the Metropolitan section junior group, ASME. The speaker was E. V. Erickson, manager of the New York export office of the Carrier Corporation, and the meeting was held November 9.

Mr. Erickson explained and described air conditioning both as to concept and various types of equipment involved in practical problems. His talk continued with a summation of what the industry expects from the air conditioning engineer, and concluded with a description of its requirements of the general engineer in the field. A question period followed the address.

S. Davidson, Armo Cooling and Ventilating Co., Inc., New York, presided at the meeting.

New York to Unify Building Depts.

NEW YORK—An entirely new method of supervising building plans and buildings in New York will go into effect January 1 under the new city charter.

Under the revised setup, the Tenement House Department will be consolidated with the Departments of Buildings of the five boroughs into a city-wide Department of Housing and Buildings. A Commissioner of Housing and Buildings will have charge of the work which now is divided among these branches of the municipal government.

The work now performed by the Tenement House Department will be continued by a Division of Housing directed by a deputy commissioner.

Those who recommended organization of the new department believe that it will serve to unify building supervision which previously has been subject to overlapping functions fostering jurisdictional disputes.

One of the notable controversies which arose recently because of this situation involved a large apartment house in Queens which had been approved by one city department but was refused an occupancy permit by another official because of the way it had been planned.

Under the present arrangement the Tenement House Department takes over responsibility for maintenance of structures over which it had no jurisdiction with respect to planning, erection or occupancy. Now one department will be charged with all of these details.

Yaglou Discusses Air Conditioning at Philadelphia ASHVE Meeting

PHILADELPHIA—If you're troubled by drafts don't be too quick to blame the open window or the air conditioning system, Prof. C. P. Yaglou of the Department of Industrial Hygiene of the Harvard School of Public Health told members of the local chapter of the ASHVE November 11 in a talk on "Comfort, Health and Therapeutic Aspects of Air Conditioning."

Research, according to Professor Yaglou, is disclosing evidence that drafts are not always caused by faulty air conditions but that complaints may be due to an inherent instability of the heat-regulating system of the body, particularly the poor blood circulation to the extremities and deficient vasomotor response in sensitive individuals. Such individuals suffer considerably on exposure to air conditions that are perfectly comfortable to the majority of normal persons.

Professor Yaglou also stressed the strides which air conditioning has made in the treatment of various diseases such as syphilis, gonorrhea, enteric disorders, heat stroke, heart failure, hay fever, pollen asthma, anoxemia, pneumonia, anemia and asphyxia. He stated that research now in progress in a number of laboratories was opening a new conception of the therapeutic value of air conditioning.

He said that the mortality rate among prematurely born infants has been greatly reduced through scientific air conditioning of hospital nurseries, lessening the incidence of respiratory and gastro-intestinal diseases, with a consequent improvement in the infants' chances of life.

Conditioned air, according to Professor Yaglou, is also becoming indispensable in reducing the risk of explosion of anesthetic gases and safeguarding the patient, surgeon, and operating personnel against excessive light for sterilizing air is of particular significance in contagious wards and operating summer heat. The recent use of ultra violet rooms.

Boston District Heating Engineers Elect Frederick, Engle

BOSTON—At the fall meeting of the Boston Section of the National District Heating Association, November 4, the following officers were elected for the ensuring year: Chairman, H. W. Frederick, Harvard University; vice-chairman, M. D. Engle, Boston Edison Company; secretary, L. W. Spink, The Foxboro Company; treasurer, F. A. Carth, *Christian Science Monitor*.

The meeting continued through the afternoon, with dinner and a business session in the evening, at the Hotel Bellevue. Reports from the national meeting were presented by various members, as follows: Distribution committee, by A. L. Dutton; hot water committee, C. R. Wilson; steam station engineering, G. A. Orrok, Jr.; operating statistics, Col. D. S. Boyden; "Hot Money and Frozen Investments," national convention prize paper, by M. A. Ulbrick, of the Cambridge Electric Light Company, author of the paper; commercial relations committee, D. W. Blair, Boston Edison Company; research committee, Prof. G. K. Saurwein, Harvard University; meters and accessories, C. L. Renker, Edison Company; advisory council report, by Harold W. Coombs, E. B. Badger Company.

The following were elected members of the executive committee, with the officers ex-officio: R. M. Nee, retiring chairman; Horace Franklin, Harold A. Coombs, and M. A. Ulbrick. Among those introduced to the members at the evening session were R. V. Kinsman, superintendent of works, and N. M. Dahl, assistant superintendent of works, Massachusetts General Hospital, with the following group that came from Springfield to attend the meeting, officials of the Springfield Gas Light Company: Robert C. O'Connor, Clifford Johnson, Alfred Bosworth, and Frank Sherman.

New Orleans to Spend $180,000 in Cooling City Auditorium

NEW ORLEANS—The City of New Orleans has awarded the contract for the installation of an air conditioning unit in its Municipal Auditorium calling for the expenditure of $180,000. An ordinance accepting the bid was adopted by the commission council November 15. The job is scheduled to be completed in time for early summer use.

The plant will, it is said, comprise the largest single refrigerating unit in the South. It will be used to cool the concert hall, seating 4160 persons and the main auditorium, seating 6440 persons.

The refrigerating machine on this job has a capacity of 700 tons, which is about half the capacity of the normal output of the ice plants of New Orleans. It will be driven by a 900-hp. steam turbine.

Dr. Young Addresses Boston Group

BOSTON—Dr. Albert G. Young, medical director of the air conditioned Corey Hill Hospital, was the guest speaker of the Air Conditioning Bureau's November 18 meeting. The ASRE Boston Section participated.

Doctor Young spoke on the success obtained from the hospital air conditioning in both winter and summer operation from a mechanical standpoint. He also discussed the effect on patients in cases of arthritis, rheumatic fever, asthma, hay fever, heart disease, and post-operative convalescence.

P. E. Fansler

NEW YORK—P. E. Fansler, at one time associate editor of HEATING & VENTILATING, and more recently editor and publisher of *Air Conditioning & Oil Heat*, died of a heart attack here November 7.

Mr. Fansler was graduated from Purdue University in 1901, and received his master's degree in 1903. While in the university, Mr. Fansler contributed to the *Lafayette (Ind.) Morning Journal*.

He was for some years assistant business manager, engineering department, J. G. White & Company. During the World War he was a government inspector of aircraft engines.

He was proud of the fact that he was the pilot of the first air line operating on a regular schedule in the United States. The line operated from Florida in 1914 and was only in existence for a few months but it was a number of years later before any other scheduled air line was begun.

In 1910, Mr. Fansler became interested in diesel engines and for many years was engaged in designing, testing, and selling them.

In 1925, Mr. Fansler became associate editor of HEATING & VENTILATING, where his knowledge and enthusiasm for oil heating could be projected over a wider field.

A forceful and convincing writer, he urged the heating industry to purge itself of the misleading advertising which was at that time widely circulated by some of the oil burner firms. Also he probably did more than any other person to publicize the degree-day unit and its possibilities, at that time hardly known outside of gas utilities. He was the author of *House-Heating with Oil Fuel*, which appeared in several editions, and of a number of pamphlets, the best known of which was devoted to his Iso Degree-Day Map and Iso-Coal, Iso-Oil and Iso-Gas Consumption maps.

Late in 1928 the publisher of HEATING & VENTILATING sponsored the monthly *Oil Heat* under the editorship of Mr. Fansler. A few months later he purchased the new publication, which he had published since.

He is survived by his wife, four sons, and two daughters.

NEW EQUIPMENT

Warren Webster Heating Control System

NAME—HYLO steam variator system, type SP.

PURPOSE—To give building operators touch control over the operation of the heating system.

FEATURES — By setting a dial for the prevailing outdoor temperatures once or twice a day it is said that the building operator can supply exactly the right amount of steam to all radiators. It is said that this control delivers steam continuously to all radiators and keeps them fractionally filled when less heat is desired. Controls for the operation of the heating system are housed in a central cabinet. This cabinet has one switch and two knobs. The switch is used for placing the control system in operation while one dial is for outdoor temperatures and the other for abnormal demands. The outdoor temperature dial is manually set to correspond with the outdoor temperatures. The other dial takes care of special conditions. When it is advanced it provides for rapid heating up and when retarded it adjusts the steam supply for reduced night heating. An operating schedule specially worked out for the building is placed on the front of each HYLO cabinet. Control is applicable to smaller office buildings, apartment houses, hospitals, residences, and similar buildings where low pressure steam is circulated through a two-pipe orificed system. Can be used on both vapor and vacuum systems. With modifications it can be used to control stokers, oil burners, and blowers and motor-operated draft dampers on hand-fired boilers.

MADE BY—*Warren Webster & Co., Camden, N. J.*

Kelvinator Evaporative Condenser

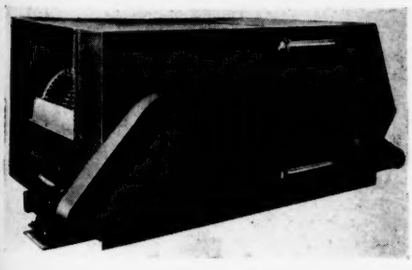
NAME—Kelvinator evaporative condenser.

PURPOSE—For condensing refrigerant gases by evaporating water.

FEATURES—Unit type construction and is said to be easily installed in any convenient location. Cabinet is made of steel with removable panels to make the interior accessible for cleaning. Brass discs revolving in a bath of water distribute a finely divided shower over the condenser coil. A small motor is used to rotate the discs. The condenser coil is of the fin type with wide fin spacing to facilitate cleaning. Eliminator plates are provided for the removal of the entrained moisture from the discharged air stream. A centrifugal-type fan is used for drawing the air over the condenser coil and discharging it to the outdoors. This condenser is designed especially for use with Kelvinator condensing units. It can be located adjacent to the condensing unit or remotely depending upon space limitations.

SIZES AVAILABLE—Five evaporative condenser sizes to match corresponding Kelvinator condensing units; capacities range from 5 to 20 tons refrigeration.

MADE BY—*Nash-Kelvinator Corp., Kelvinator Div., Detroit.*



Crane Autocoal Stoker

NAME—Crane Autocoal stoker.

PURPOSE—For automatic firing of coal.

FEATURES—Each stoker is provided with a room thermostat, hold fire control, limit control, and a clinker tong. Main advantages claimed are economy of operation and maintenance.

SIZES AVAILABLE—Five sizes with hopper capacities of 350 and 500 lb. with varying coal feeds.

MADE BY—*Crane Co., Chicago, Ill.*

M-H Pneumatic Thermostat

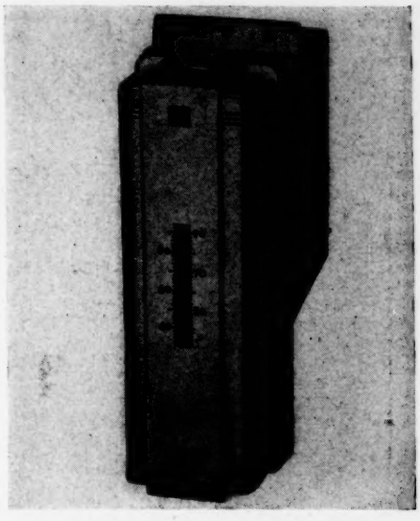
NAME—Pneumatic Submaster room thermostat.

PURPOSE—For regulating temperatures in a room with relationship to conditions at another point. Can be used with all types of heating and cooling equipment where graduated control by compressed air is desired.

FEATURES—Thermostat will control the temperature in a room in accordance with the conditions at some other point. In the summer, for example, this thermostat will, when under the regulation of a master controller placed at an outside location, raise the inside temperature from 72 to 82F as the outdoor temperature rises from 70 to 100F. All moving parts operate in a sealed chamber.

METHOD OF OPERATION—A pipe line leads from the master controller to a bellows arrangement on the back of the submaster thermostat. Increasing or decreasing the air pressure in this bellows mechanically changes the setting of the Submaster indicator. A simple switch-over arrangement is provided so that the Submaster feature can be disconnected and the thermostat will operate as a conventional room thermostat. The scale range is from 46 to 90F with scale markings every four degrees.

MADE BY—*Minneapolis-Honeywell Regulator Co., National Regulator Division, Minneapolis, Minn.*



Torrington Steel Blower Wheels

NAME—Torrington steel blower wheels.

PURPOSE—Small blower wheels for applications where an inexpensive small wheel is desired.

FEATURES—The manufacturer states that while the cost of these wheels will be less, they will be built to the same high quality standards as other Torrington wheels. They are made of pressed steel.

SIZES AVAILABLE—3 in. to 9 in. diameter in conventional standard widths.

MADE BY—*The Torrington Mfg. Co., Torrington, Conn.*

Mercoid Hot Water Control

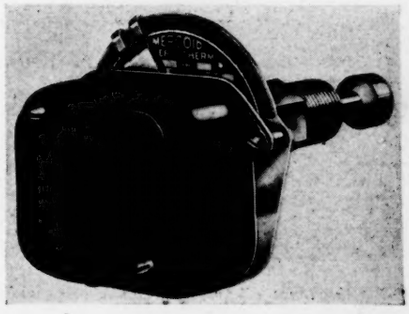
NAME—Immersatherm.

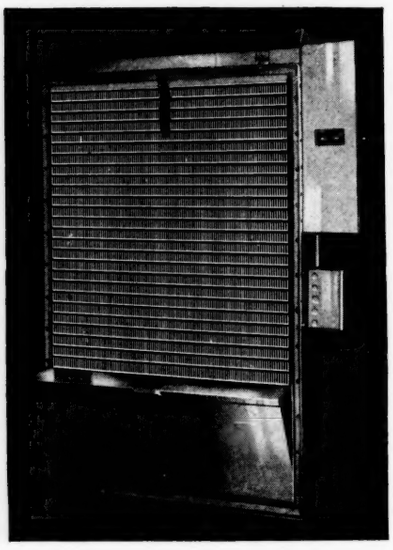
PURPOSE—For controlling water temperatures.

FEATURES—Control can be used with steam, vapor, and hot water systems employing indirect hot water heaters. It is said that this control is extremely sensitive to boiler water changes. Sealed mercury switch used in this control remains in a stationary position and operation is by means of a small permanent magnet that is actuated by a small bimetal coil enclosed in a copper shell housing through which the water temperature is transferred.

LITERATURE AVAILABLE—Bulletin 125.

MADE BY—*The Mercoid Corp., Chicago, Ill.*





American Multi-Panel Air Filter

NAME—"Armored" multi-panel air filter.

PURPOSE—A special type of panel construction to provide three stages of air cleaning in a curtain type filter.

FEATURES—"Armored" panel is a combination of woven screen and a die-stamped louver section. The louver section consists of closely spaced vertical streamline-shaped baffles and forms the lower or exposed area of the panel. The upper part of the woven screen section which is at the back of the filter curtain is bakelite fiber coated to obtain high efficiency in the removal of fine dust particles from the air. The lower part of the screen section which lies immediately behind the "armored" section of the preceding panel is left uncoated to provide a second or intermediate stage of air cleaning. Lint and coarse granular dust are collected on the "armored" section of the filter curtain. The baffles have ample storage surface to handle a large quantity of bulky material without restricting the air flow, and being vertical permits this accumulation to be removed in the oil bath. The added weight of the "armored" section is said to improve the self-cleaning action by accelerating the movement of the panel through the oil bath. This actively forces the oil through screen section of the panel to obtain more positive removal of the dust accumulation. Now standard equipment on all multi-panel filters. Also interchangeable with former screen panels and any multi-panel now in service.

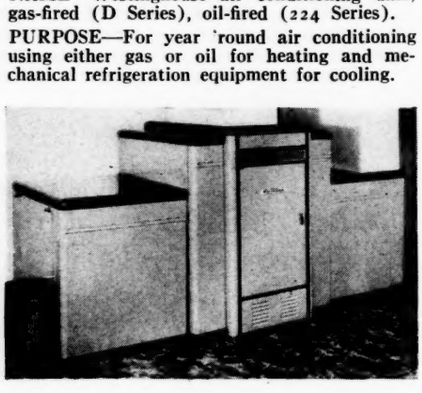
LITERATURE AVAILABLE—Bulletin 240-C.

MADE BY—*American Air Filter Co., Inc., Louisville, Ky.*

Westinghouse Air Conditioning Unit

NAME—Westinghouse air conditioning unit; gas-fired (D Series), oil-fired (224 Series).

PURPOSE—For year 'round air conditioning using either gas or oil for heating and mechanical refrigeration equipment for cooling.



Westinghouse oil-fired air conditioning unit

FEATURES—In the gas-fired units the burner radiator is constructed of No. 12 gage steel, while the drum of the heating element is made from boiler plate steel. All seams are welded after being riveted. The blower compartment is located at the rear of the burner compartment. The summer air conditioning compartment which houses the mechanical refrigerating equipment is attached to one side of the furnace compartment. Air is cooled by means of a cooling coil placed in the supply duct. The oil-fired air conditioning unit is similar to the gas-fired unit except that the blower compartment, like the cooling compartment, is mounted on the side of the heat compartment. Cabinets for both the oil- and gas-fired series are constructed of 20 gage cold rolled furniture stock and are finished with a glossy enamel.

SIZES AND CAPACITIES—Gas-fired model available in four sizes with capacity at register ranging from 107,000 B.t.u. to 267,000 B.t.u. per hr.

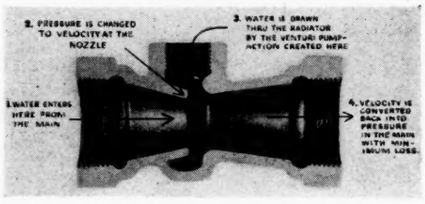
MADE BY—*Westinghouse Electric & Mfg. Co., Mansfield, Ohio.*

Taco One-Pipe Hot Water System

NAME—The "Taco-One" venturi hot water heating system.

PURPOSE—A single pipe hot water heating system for buildings requiring up to 1000 sq. ft. of radiator surface.

FEATURES—Heating system utilizes only one main. The supply side of the radiator is connected to the main with an ordinary tee while the return side is connected with a Taco venturi fitting. This fitting is designed to cause a suction on the return from the radiator so as to draw hot water through the radiator. One size of pipe is used throughout the entire main. Venturi fittings are tapped


2. PRESSURE IS CHANGED TO VELOCITY AT THE NOZZLE
3. WATER IS DRAWN THRU THE RADIATOR BY THE VENTURI PUMP-ACTION CREATED HERE
1. WATER ENTERS HERE FROM THE MAIN
4. VELOCITY IS CONVERTED BACK INTO PRESSURE IN THE MAIN WITH MINIMUM LOSS

with ½-in. connections and one size pipe may be used to all size radiators. One size circulator is used on most jobs up to 1000 sq. ft. of radiator surface. A single flow check on the boiler outlet is provided to prevent hot water from backing out of the boiler into the radiators during periods when heat is not needed. Special bronze Taco venturi fittings are available for systems using copper instead of steel pipe.

SIZES—For buildings requiring up to 1000 sq. ft. of radiator surface.

MADE BY—*Taco Heaters, Inc., 342 Madison Ave., New York.*

McLeod & Henry Combustion Chambers

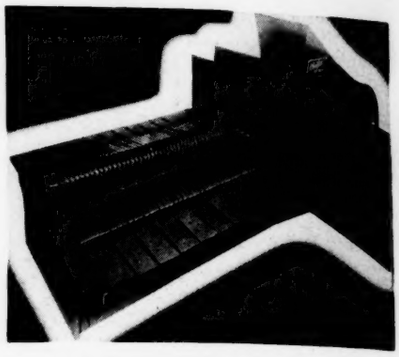
NAME—Steel mixture combustion chambers.

PURPOSE—Combustion chamber for domestic oil burners.

FEATURES—Combustion chambers are made of Pennsylvania fire clay which is said to have a high fusion point and a texture and hardness suited to resisting the flame impingement, sudden temperature changes and vibratory shock encountered in oil firing. A complete combustion chamber consists of one burner port block and any required number of identical and interchangeable sidewall blocks. Standard fire bricks are used for base or flooring. The manufacturer states that the design of the blocks permits lining the walls of any stoker with only two shapes of bricks.

LITERATURE AVAILABLE—Circular No. H-V-8.

MADE BY—*McLeod & Henry Co. Inc., Troy, N. Y.*



Canton Underfeed Stoker

NAME—Canton ram type underfeed stoker.

PURPOSE—For automatic burning of coal.

FEATURES—The manufacturer states that this stoker is of the low headroom type and requires 12 in. less headroom than ordinary stokers. Among the special features are the dustproof gear box; anti-friction bearings; motor mounted 24 in. off floor; retort ram adjustable while stoker is in operation; seven feed adjustments; and guarantee for five years.

MADE BY—*Canton Stoker Corp., Andrew Place, SW., Canton, Ohio.*

ADSCO-Corning Insulation

NAME—ADSCO-Corning filler insulation.

PURPOSE—For the insulation of underground steam lines.

FEATURES—The insulation is composed of long flexible fibers of glass in a soft resilient mass resembling cotton batting but possessing the permanence and chemical characteristics inherent in glass. Heat conductivity is 0.33 B.t.u. per hr. at 4 lb. density. The material is said to fluff instead of settling under vibration. It is fireproof and unaffected by water, acid, or fumes. Can be used for pipe lines operating at temperatures of 650F or higher when required.

LITERATURE AVAILABLE—Bulletin No. 35-67.

MADE BY—*Corning Glass Works for the American District Steam Co., North Tonawanda, N. Y.*

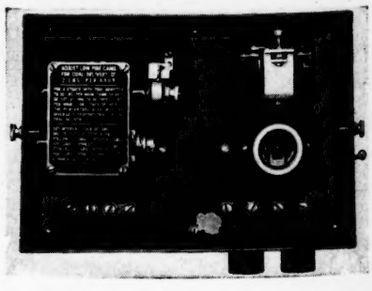
Russell Stoker Timer Relay

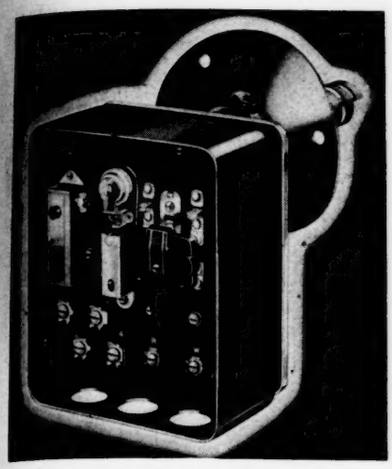
NAME—DeLuxe timer relay for stokers.

PURPOSE—For controlling stoker operation.

FEATURES—The induction disc motor employs a light aluminum rotor disc to reduce the weight of bearings and pivots. Sapphire jewel bearings with hardened, burnished pivots are employed. Motor turns at an average speed of 300 r.p.m. All adjustments can be made without tools. Line voltage switch and fuse receptacle are included as standard equipment. The entire mechanism is sealed in a die-cast case to keep out dust. The kindling firing period can be adjusted anywhere from 20 to 50 min. and another adjustment is provided to vary the percentage of feeding period as required.

MADE BY—*Russell Electric Co., Chicago, Ill.*





Penn Stack Controls

NAME AND MODEL NUMBER—Penn Saftrols, type 670 (continuous ignition) and type 672 (intermittent ignition).

PURPOSE—Stack safety combustion controls for a.c. service on all types of oil burners.

FEATURES—These controls, which are completely restyled both externally and internally, incorporate all the features formerly available in the Penn stack switch line. In addition they offer voltage protection, a feature which is said to give positive automatic shutdown of the burner to guard against ignition failure in the event of subnormal voltages in the supply line.

CAPACITY—One horsepower single phase at 110 volts.

MADE BY—*Penn Electric Switch Co., Goshen, Ind.*

Ideal Electric Soldering Pliers

NAME—No. 2 midget type thermo-grip pliers.

PURPOSE—For soldering joints on small copper tubing and fittings up to ⅜ in. in diameter.

FEATURES—This tool has been designed especially for soldering small objects and for working in restricted spaces. It can be used on any standard lighting circuit without danger of overloading because of the small power requirement of 300 watts. Pliers are made of cast bronze with the jaws hinged at the back and provided with a spring which holds them normally in the open position.

MADE BY—*Ideal Commutator Dresser Co., 1098 Park Ave., Sycamore, Ill.*

Kisco Gas-Fired Boiler

NAME—Kisco gas-fired boiler.

PURPOSE—For supplying steam using gas as a fuel.

FEATURES—All parts of the boiler are exposed to the hot fuel gases. The gases first strike the bottom and sides of the boiler, then travel through the fire tubes and then pass over the top, superheating the steam. A large steam space is provided to assure a continuous flow of dry steam. The boiler is designed especially for gas. It is furnished with all necessary fittings, including burners, gas regulator, try-cocks, water gage set, gas cock, safety valve, blow-down valves, and steam gage. It is furnished completely assembled.

SIZES AND CAPACITIES—Eight sizes varying from 1½ to 15 boiler hp.

MADE BY—*Kisco Boiler & Engineering Co., 4333-35 Duncan Ave., St. Louis, Mo.*

Bell & Gossett Water Heater

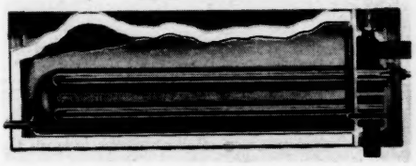
NAME—The Thermo-voir.

PURPOSE—A tankless heater for supplying domestic hot water using boiler water as a heat source.

FEATURES—The Thermo-voir is said to combine the best features of both tankless and storage hot water systems. In operation city water fills the outside reservoir after entering through the pipe to the lower left. Here it is heated by the boiler water which flows through the large inner pipes. When water is withdrawn the preheated water in the reservoir passes through two series of copper tubing before going to the fixtures. Thus the reservoir provides a reserve supply of hot water and the copper tubes act as instantaneous heaters. The manufacturer states that because the water stored in the reservoir absorbs heat from the boiler during off periods of the burner, there is no need for constantly maintaining the usual 160 to 180F boiler water temperature. Thus standby loss is reduced to a minimum.

TYPES AVAILABLE—Two models available, the DeLuxe constructed of non-ferrous metals and heavy air cell insulation, and the Standard with galvanized steel and no insulation.

MADE BY—*Bell & Gossett Co., 3000 Wallace St., Chicago, Ill.*



Rockwood Fibre Laggings

NAME—Rockwood fibre laggings.

PURPOSE—Fibre lagging to increase both the diameter of pulleys and the transmitting capacity of belts.

FEATURES—These laggings are made of the same material as Rockwood paper pulleys. The compressed end grain fibre belt surface is said to make an ideal pulling surface which grips and pulls the belt without slip. Laggings are applied on the wheel rim with a special clamp. This results in an increase diameter which in turn results in increase in the size of the motor pulley and higher belt speeds. The lagging also has the effect of increasing capacity because of the special gripping action.

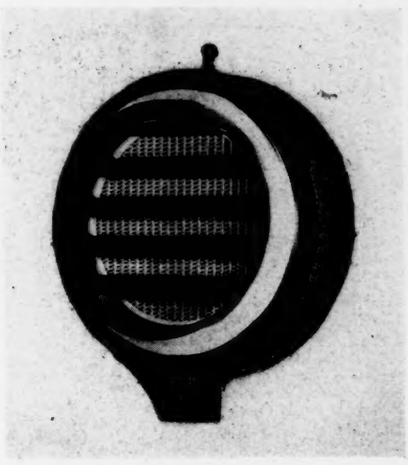
MADE BY—*Rockwood Mfg. Co., 1801-2001 English Ave., Indianapolis, Ind.*

Hexcel Cooling and Heating Units

NAME AND MODEL NUMBER—Hexcel universal units, Models A and AA.

PURPOSE—For heating and cooling using low pressure steam or hot water for heating and cold water for cooling.

FEATURES—Unit is built in two types, a pedestal type for floor installations and a suspension type for ceiling installations. An all-



copper core is used for the heat transfer surface and the tubes are brazed in heavy gage brass header plates with tanks drawn out of sheet brass. Directional rotating louver can be set at any angle, directing the hot or cold air in any direction desired. Units finished in brown crackle lacquer body with heavy bead of chromium. Air louver is ebony black. A two-speed motor gives either high or medium air delivery.

SIZES AND CAPACITIES—Model A unit gives a maximum air delivery of 334 c.f.m.; heat output, 32,600 B.t.u. per hr. For cooling 95F air with water at 55F, air temperature will be reduced to 71F. Model AA unit gives a maximum air delivery of 610 c.f.m.; heat output, 54,200 B.t.u. per hr. When cooling 95F air with water at 55F, air temperature will be reduced to 71F.

MADE BY—*Hexcel Radiator Co., Racine, Wis.*

Sarco Bucket Trap

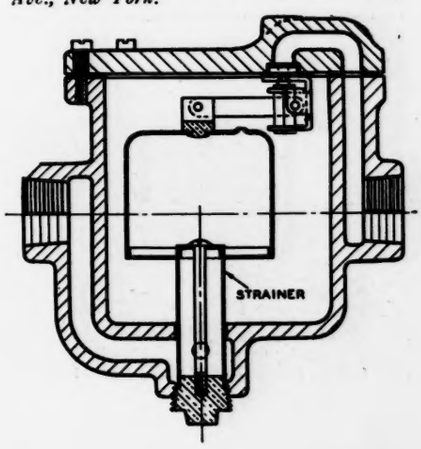
NAME AND MODEL NUMBER—Straightway inverted bucket steam traps, models BMO and BHO.

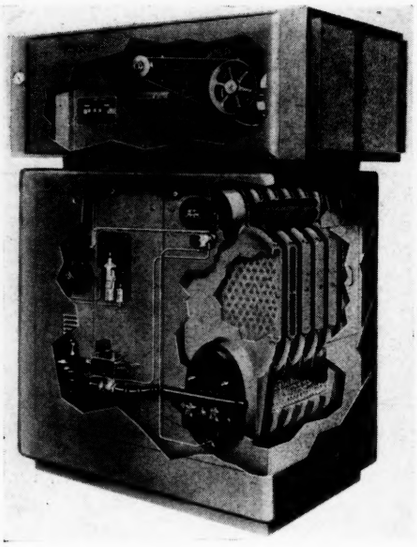
PURPOSE—To allow the passage of steam condensate.

FEATURES—Inlet and outlet connections are arranged on opposite sides of the body on the same center line to provide a straight-through connection. This arrangement has the advantage of simplifying the pipe connections in a number of installations, particularly in connection with small equipment. As in all other Sarco inverted types this trap has all the working mechanism attached to the trap cover so that it can be removed by lifting off the cover without disturbing the pipe connections. A strainer is built in the trap.

SIZES—One size with either ⅜ or ½ in. inlet and outlet connections.

MADE BY—*Sarco Co., Inc., 183 Madison Ave., New York.*





AGP Gas-Fired Conditioner

NAME AND MODEL NUMBER—AGP gas-fired air conditioner, type 2-FE.

PURPOSE—For heating, humidifying, filtering and circulating air.

FEATURES—This winter air conditioning unit operates on a counter-flow principle. The fan unit, mounted on top, blows air down over the heating surface in counter-flow to the upward passage of the products of combustion on the other side of the heating surface. The manufacturer states that this counter-flow principle increases the rate of heat transfer from metal to air and reduces the weight and size of the heating sections. Extended pin heating surfaces are used on the inner flue surfaces. A single combustion chamber is used for all sizes. All of the controls are concealed within the casing of the unit.

MADE BY—*American Gas Products Corp., 40 W. 40th St., New York.*

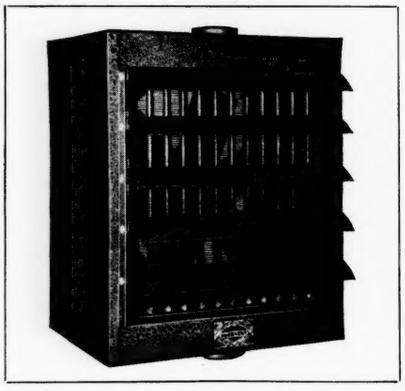
Autovent Unit Heater

NAME—Autovent unit heater.

PURPOSE—A small unit heater for heating small rooms and isolated offices.

FEATURES—This unit has a rating of 61 ft. of equivalent direct radiator surface and a capacity of 14,640 B.t.u. with an output of steam pressure of 60F. A specially designed propeller fan forces 440 c.f.m. of warm air through the adjustable vanes on the front of the heater. Finished in a golden bronze, crackle finish. Motor is suitable for constant or two-speed operation.

MADE BY—*Autovent Fan & Blower Co., 1811-13 N. Kostner Ave., Chicago, Ill.*



Lovejoy Flexible Coupling

NAME AND MODEL NUMBER—Lovejoy flexible coupling, type WQ.

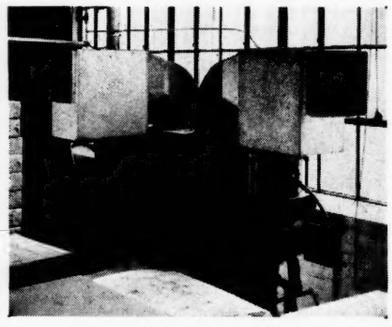
PURPOSE—For use where it is necessary to disconnect the driven machine for timing or setting the engine.

FEATURES—Coupling has one set of jaws made in the form of a removable ring. This ring is held in place and driven by 3, 5, 7, or 9 hexagon cap screws which operate from the jaw body. As the pilot which holds the jaw ring in place is ⅛ in. deep, while the gap between the cushions and the jaw body is 3/16 in., when the removable jaw ring is pulled over there develops a clearance of 1/16 in. which is ample for rotating either half of the coupling. This disconnecting is secured without moving the load cushions or steel retaining band. The only work necessary is to take out the cap screws and reverse them so that they operate from the other body. Three types of cushions are used.

Cushions on the L-R type WQ are free floating between the metal jaws; that is, the internal end rests on the hub. They are retained in place by a steel band. Cushions are free to move and adjust themselves instantly to any momentary position of the jaws. In operation, one half of the cushions are idlers (except on reversing loads) hence there is always a set of new cushions in the coupling. They are in plain sight, and in case of readjustment, they can be lifted out and interchanged without tearing down the coupling, thus obviating costly and annoying shut-downs.

SIZES—Made in standard sizes with bores from 1½ in. to 14 in. (2 to 2000 hp. at 100 r.p.m.)

MADE BY—*Lovejoy Flexible Coupling Co., 5022 W. Lake St., Chicago, Ill.*



Humidity Box

NAME—Humidity box.

PURPOSE—For introducing moisture in spaces warmed by unit heaters.

FEATURES—This device is essentially a spray or fog chamber and is provided with a water filter and nozzle, air filter and eliminator or baffle, and drain fitting. When water pressures of 30 lb. per sq. in. or over are available, this device works directly from the water line. Under these pressures an electric vaporizer is used to secure atomization. Illustration shows two humidity boxes on the warm air outlets of a blower type unit heater. It can also be used with a propeller fan type unit heater or with warm air ducts.

MADE BY—*The Air Conditioning Supply Co., 1893 E. 55th St., Cleveland, Ohio.*

Bell & Gossett Controls

NAME—Bell & Gossett electrical controls.

PURPOSE—Control of water heaters and heating systems.

FEATURES—This line of controls includes thermostats, hot water controls, pressure controls, fan controls and relays. All of the limit controls employ a twin contact switch

mechanism. Magnetic acceleration is employed so that snap action is insured on both opening and closing of the contact.

LITERATURE AVAILABLE—Bulletin CTP-1037.

MADE BY—*Bell & Gossett Co., 3000 Wallace St., Chicago, Ill.*

Bryant Duct Heater

NAME AND MODEL NUMBER — Bryant model D-85-C duct heater.

PURPOSE—A gas-fired heater operating on the same principle as a steam coil.

FEATURES — Manufacturer states that this heater can serve as an auxiliary heater in a central fan type distribution system. It is applicable to office buildings, theaters, stores, and auditoriums where heat requirements can not be met with present equipment. Required minimum air flow through the equipment is 1000 c.f.m. Standard equipment includes chromium steel alloy heat exchanger tubes, cast-iron combustion chamber and flue collector, combination snap valve and pressure regulator, thermo pilot, fixed burner orifices, built-in draft diverter, 1-in. pipe hanger support brackets, and a blue crackle finish jacket.

SIZES AND CAPACITIES—Designed to fit a standard 17¾ by 17¾ in. duct, input rating 85,000 B.t.u. per hr.

LITERATURE AVAILABLE—Bulletin 310.

MADE BY—*The Bryant Heater Co., 17825 St. Clair Ave., Cleveland, Ohio.*

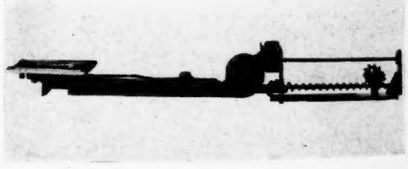
Iron Fireman Stoker

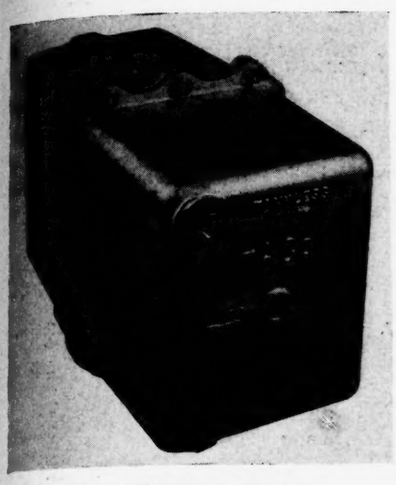
NAME — Commercial-industrial chain drive stoker.

PURPOSE—A bin-fed stoker designed for use in boiler rooms where maximum clearance is required immediately in front of boiler.

FEATURES—Gear case and fan unit is mounted next to wall of the coal bin. The driving end of the stoker is of a new type. Power from the motor is transmitted by means of a shaft to the back of the unit, where a chain drive connects the shaft and the feed worm. The drive is sealed in a grease-packed housing.

MADE BY—*Iron Fireman Manufacturing Co., Cleveland, Ohio.*





Taco Tankless Heater

NAME AND MODEL NUMBER—External tankless heater No. 18.

PURPOSE—For supplying domestic hot water without use of a storage tank.

FEATURES—The shell of the heater is made of cast iron while the coils are of copper permanently expanded into bronze terminals. All waterways are of bronze or copper. Provision is made for draining the heater. When this heater is used for supplying hot water no storage tank is necessary.

CAPACITY—300 g.p.h.; 100F temperature rise using water at 180F.

MADE BY—*Taco Heaters, Inc., 342 Madison Ave., New York.*

Square D Float Switch

NAME AND MODEL NUMBER—Screw-in tank float switch, Class No. 9137, types FB_1 and FB_3.

PURPOSE—For control of pumps regulating liquid level.

FEATURES—Switches are complete units in themselves and are composed of the switch mechanism, cadmium-plated brass float, linkage for transmitting the movement of the float to the switch mechanism, and a screw-in connection. Float travel adjustments can be made on the outside of the tank and can be sealed. The graphite-coated asbestos packing used is suitable for steam, hot or cold water and oil, where the tank pressure does not exceed 50 lb. per sq. in.

MADE BY—*Square D Co., Regulator Division, Detroit, Mich.*

M.S.A. Explosimeter

NAME—Explosimeter.

PURPOSE—For rapid determination of the presence of combustible gas hazards.

FEATURES—This instrument is designed to meet the demand of operating men for a portable instrument to show explosive gas concentrations. In size and weight the Explosimeter compares with a small folding camera.

PRINCIPLE OF OPERATION—By operating a small piston-type pump a sample of the atmosphere to be tested is drawn through a length of hose into the instrument. Sampling line of practically any length may be used with no lag in the indicator reading except the time required to draw sample through the line. In the Explosimeter the gas sample flows over a hot platinum wire which forms a part of a balanced electrical circuit, current for which is provided by a small two-cell dry battery. This detector unit is balanced against the filament of a small electric light bulb burning in an inert atmosphere. Combustion of gases on the surface of the detector filament creates an increase in the temperature of the wire and consequently an increase in resistance, thus causing the electrical circuit to be unbalanced. This unbalancing of the circuit causes a deflection of the pointer of the electrical meter proportional to the concentration of gas in the atmosphere being tested. The concentration of gas may be read directly on the meter.

MADE BY—*Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh, Pa.*

Young Damper Regulator

NAME—Valcalox damper regulator.

PURPOSE—For setting and indicating the position of dampers.

FEATURES—The manufacturer claims 12 points important to proper damper control. These are secure locking; no slipping of dampers; sleeve to receive bearing or bar; positive action; indication of damper position at all times; use with all styles of dampers; location on partition wall or any location of ducts; 360° rotation; elimination of corrosion through zinc alloy base; bearings permit easy installation of dampers in small ducts; wrench, bearing, screws and nuts cadmium plated; and bearing with pressed fit.

MADE BY—*Young Regulator Co., 4500 Euclid Ave., Cleveland, Ohio.*

Kisco Oil-Fired Boiler

NAME—"Dual-Heat" automatic oil-fired boiler.

PURPOSE—For supplying steam using oil as a fuel.

FEATURES—Boiler is especially designed for oil fuel. Incorporated with the boiler is a complete combustion chamber with fire brick lining all ready for the oil burner. A special heating coil in the upper part of the combustion chamber is used to increase the heating surface and shorten the time of steaming. Hot gases from the combustion chamber are circulated around the outside of the boiler, thus heating the water from both sides. Automatic oil burner is supplied complete with automatic ignition and pump cut-out.

MADE BY—*Kisco Boiler & Engineering Co., 4333-35 Duncan Ave., St. Louis, Mo.*

Ohio Resilient Motor Mounting

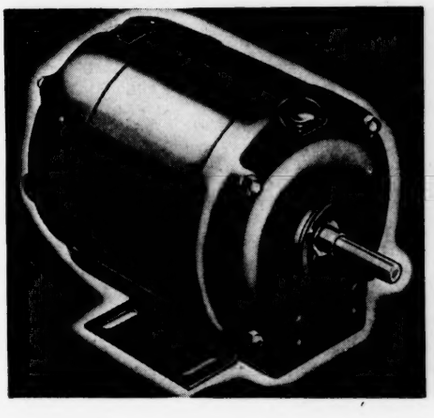
NAME—Ohio resilient motor mounting.

PURPOSE—For reducing the transmission of vibration.

FEATURES—The cushioning rings of this motor mounting are said to be not affected by oil or heat. If desired, the motor may be removed by loosening the end pieces and without touching the base.

SIZES—Made in 1/6, 1/5, 1/4, and 1/3 hp. sizes.

MADE BY—*The Ohio Electric Mfg. Co., Cleveland.*



STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF MARCH 3, 1933, OF HEATING & VENTILATING, published monthly at New York, N. Y., for October 1, 1937.

State of New York, County of New York, ss.:

Before me, a Notary Public in and for the State and County aforesaid, personally appeared Edgar A. Becker, who, having been duly sworn according to law, deposes and says that he is the Treasurer of The Industrial Press, publishers of Heating & Ventilating and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, The Industrial Press, 140-148 Lafayette St., New York, N. Y.

Editor, C. H. B. Hotchkiss, 140-148 Lafayette St., New York, N. Y.

Managing Editor, Clifford Strock, 140-148 Lafayette St., New York, N. Y.

Business Managers, Robert B. Luchars, 140-148 Lafayette St., New York, N. Y.; Edgar A. Becker, 140-148 Lafayette St., New York, N. Y.; Erik Oberg, 140-148 Lafayette St., New York, N. Y.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

The Industrial Press, 140-148 Lafayette St., New York, N. Y.; Erik Oberg, 140-148 Lafayette St., New York, N. Y.; Robert B. Luchars, 140-148 Lafayette St., New York, N. Y.; Edgar A. Becker, 140-148 Lafayette St., New York, N. Y.; Laura A. Brownell, 140-148 Lafayette St., New York, N. Y.; Franklin D. Jones, 140-148 Lafayette St., New York, N. Y.; First National Bank and Trust Co. of Montclair and Robert B. Luchars, Trustees (Beneficiaries unknown), Upper Montclair, N. J.; First National Bank and Trust Co. of Montclair and Leigh Roy Urban, Trustees (Beneficiaries unknown), Upper Montclair, N. J.; First National Bank and Trust Co. of Montclair and Kenneth D. Ketchum, Trustees (Beneficiaries unknown), Upper Montclair, N. J.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are:

Laura A. Brownell, 140-148 Lafayette St., New York, N. Y.; John Connolly, 140-148 Lafayette St., New York, N. Y.; Franklin D. Jones, 140-148 Lafayette St., New York, N. Y.; Robert B. Luchars, 140-148 Lafayette St., New York, N. Y.; Louis Pelletier, 140-148 Lafayette St., New York, N. Y.; Elizabeth Y. Urban, 163 Western Drive, Longmeadow, Mass.; Helen L. Ketchum, Atlantic Ave., Cohasset, Mass.; Wilbert A. Mitchell, 28 Harlow Rd., Springfield, Vt.; Henry V. Oberg, 28 Spencer Ave., Lancaster, Pa.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

EDGAR A. BECKER, Treasurer.

Sworn to and subscribed before me this 21st day of September, 1937.

CHARLES P. ABEL

Notary Public, Kings County No. 302; Kings Register No. 9126; N. Y. County No. 197; N. Y. Register No. 9-A-147. My commission expires March 30, 1939.

Degree-Day Figures for October, 1937

HEATING & VENTILATING continues its tenth year of publishing degree-day data for various large cities

	Albany, N. Y.	Atlanta, Ga.	Baltimore, Md.	Birmingham, Ala.	Boston, Mass.	Buffalo, N. Y.	Burlington, Vt.
Degree-days for October, 1937.....	435	228	283	186	387	528	545
Degree-days, Sept. 1, 1937 to Oct. 31, '37	599	247	344	193	515	709	771
Degree-days, Sept. 1, 1936 to Oct. 31, '36	511	90	223	74	460	542	746
Degree-days, Sept. 1 to Oct. 31, Normal	518	96	223	0	411	494	625

	Cheyenne, Wyo.	Chicago, Ill.	Cincinnati, Ohio	Cleveland, Ohio	Columbus, Ohio	Denver, Colo.	Des Moines, Iowa
Degree-days for October, 1937.....	506	443	376	453	409	348	423
Degree-days, Sept. 1, 1937 to Oct. 31, '37	668	563	479	587	521	417	513
Degree-days, Sept. 1, 1936 to Oct. 31, '36	851	426	334	423	362	619	464
Degree-days, Sept. 1 to Oct. 31, Normal	845	356	248	393	313	500	357

	Detroit, Mich.	Dodge City, Kan.	Duluth, Minn.	El Paso, Tex.	Erie, Pa.	Evansville, Ind.	Fort Wayne, Ind.
Degree-days for October, 1937.....	519	273	741	41	480	298	472
Degree-days, Sept. 1, 1937 to Oct. 31, '37	697	299	1027	41	634	346	628
Degree-days, Sept. 1, 1936 to Oct. 31, '36	534	458	1021	147	449	231	456
Degree-days, Sept. 1 to Oct. 31, Normal	442	276	881	40	411	155	347

	Fort Worth, Tex.	Grand Rapids, Mich.	Green Bay, Wis.	Harrisburg, Pa.	Hartford, Conn.	Indianapolis, Ind.	Ithaca, N. Y.
Degree-days for October, 1937.....	78	506	597	385	423	398	522
Degree-days, Sept. 1, 1937 to Oct. 31, '37	79	670	796	497	577	507	743
Degree-days, Sept. 1, 1936 to Oct. 31, '36	178	572	717	343	471	359	572
Degree-days, Sept. 1 to Oct. 31, Normal	0	476	505	329	392	298	443

	Kansas City, Mo.	Knoxville, Tenn.	La Crosse, Wis.	Lansing, Mich.	Lincoln, Neb.	Little Rock, Ark.	Los Angeles, Calif.
Degree-days for October, 1937.....	290	285	533	572	362	183	19
Degree-days, Sept. 1, 1937 to Oct. 31, '37	325	305	696	796	416	198	19
Degree-days, Sept. 1, 1936 to Oct. 31, '36	327	135	648	672	438	142	25
Degree-days, Sept. 1 to Oct. 31, Normal	214	183	558	481	316	47	0

	Louisville, Ky.	Madison, Wis.	Memphis, Tenn.	Milwaukee, Wis.	Minneapolis, Minn.	Nashville, Tenn.	New Haven, Conn.
Degree-days for October, 1937.....	320	534	204	505	571	260	396
Degree-days, Sept. 1, 1937 to Oct. 31, '37	391	694	223	650	737	294	523
Degree-days, Sept. 1, 1936 to Oct. 31, '36	257	638	146	562	671	167	422
Degree-days, Sept. 1 to Oct. 31, Normal	186	546	62	534	574	136	399

	New Orleans, La.	New York, N. Y.	Norfolk, Va.	Oklahoma City, Okla.	Omaha, Neb.	Peoria, Ill.	Philadelphia, Pa.
Degree-days for October, 1937.....	41	328	209	172	389	427	317
Degree-days, Sept. 1, 1937 to Oct. 31, '37	41	419	225	186	458	542	392
Degree-days, Sept. 1, 1936 to Oct. 31, '36	12	307	95	277	469	408	258
Degree-days, Sept. 1 to Oct. 31, Normal	0	276	99	105	329	384	242

	Pittsburgh, Pa.	Portland, Me.	Portland, Oreg.	Providence, R. I.	Reading, Pa.	Reno, Nev.	Richmond, Va.
Degree-days for October, 1937.....	425	481	186	417	358	336	298
Degree-days, Sept. 1, 1937 to Oct. 31, '37	544	661	275	544	459	412	356
Degree-days, Sept. 1, 1936 to Oct. 31, '36	341	639	296	453	337	132	170
Degree-days, Sept. 1 to Oct. 31, Normal	313	563	437	410	344	453	158

	Rochester, N. Y.	St. Louis, Mo.	Salt Lake City, Utah	San Francisco, Calif.	Scranton, Pa.	Seattle, Wash.	Spokane, Wash.
Degree-days for October, 1937.....	511	289	287	92	459	258	386
Degree-days, Sept. 1, 1937 to Oct. 31, '37	707	336	333	226	632	394	524
Degree-days, Sept. 1, 1936 to Oct. 31, '36	508	264	434	215	480	445	586
Degree-days, Sept. 1 to Oct. 31, Normal	503	205	406	260	457	595	707

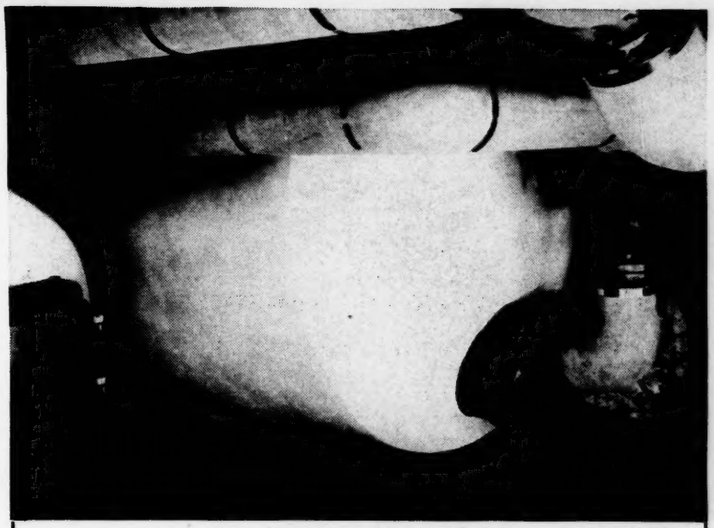
	Springfield, Ill.	Syracuse, N. Y.	Toledo, Ohio	Trenton, N. J.	Utica, N. Y.	Washington, D. C.	Wichita, Kan.
Degree-days for October, 1937.....	358	471	480	354	477	313	252
Degree-days, Sept. 1, 1937 to Oct. 31, '37	438	658	641	459	685	391	279
Degree-days, Sept. 1, 1936 to Oct. 31, '36	329	506	466	334	546	228	347
Degree-days, Sept. 1 to Oct. 31, Normal	282	521	378	242	612	251	192

Methods of applying the degree-day in connection with the operation of heating plants or for the prediction of fuel consumption of heating plants are described fully in the DEGREE-DAY HANDBOOK, published in 1937, by HEATING & VENTILATING, 148 Lafayette Street, New York, price $3. Degree-days as given above for a "normal" month or season are based on averages for a long period of years, ending about 1922. Averages covering different periods will disagree with the above figures slightly.

For tanks and heaters that will serve long and well . . . the choice is EVERDUR SILICON BRONZE

INCREASINGLY frequent installations all over the country testify to the acceptance of EVERDUR as the ideal metal for non-rust heater tanks. In colleges and schools . . . hotels . . . clubs . . . hospitals . . . laundries . . . private homes—wherever the demand is for a permanent supply of clean hot water, EVERDUR is the popular favorite. Installations of this Anaconda metal will continue to operate faithfully long after tanks of rustable metal have been discarded.

EVERDUR is strong as steel, yet rustless as copper. It is readily welded by all common methods. The combination of excellent corrosion-resistance with high strength and ready weldability spells lasting, repair-free service at reasonable cost. Obtainable from leading equipment manufacturers.



One Everdur non-rust Storage Heater supplies these two University Buildings

GYMNASIUM and DORMITORY—This 54" x 144" Whitlock Everdur Type K Heater was installed in the Southwick Memorial Building (right) at the University of Vermont, Burlington, Vt. This building is a women's recreational center, including gymnasium and auditorium. The heater also supplies hot water to the Redstone Dormitory (left). It has an hourly capacity of 1750 gallons and was made by the Whitlock Coil Pipe Co., Hartford, Conn.

37161

ANACONDA from mine to consumer

Everdur Metal

RUSTLESS AS COPPER
STRONG AS STEEL

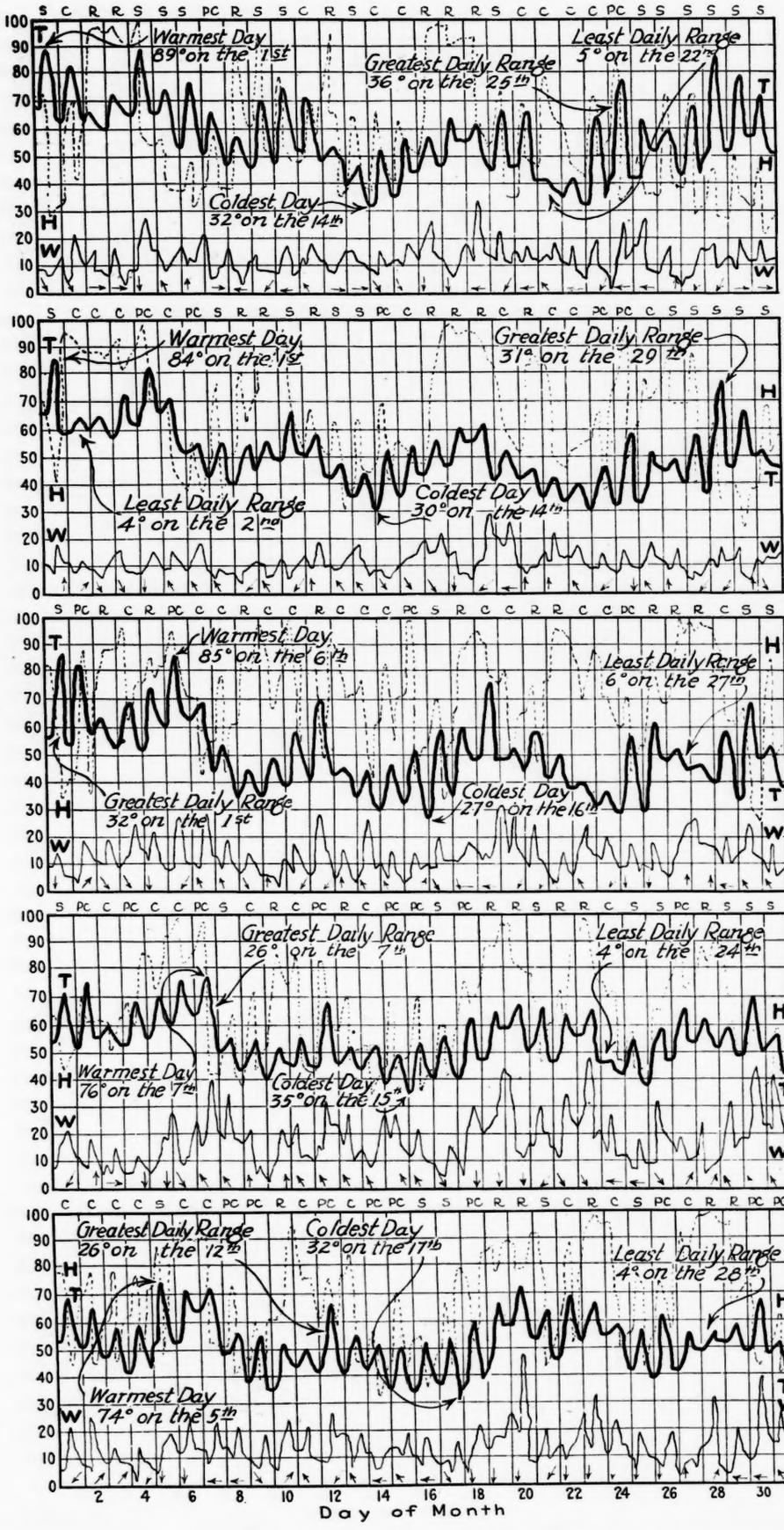
THE AMERICAN BRASS COMPANY, General Offices: WATERBURY, CONNECTICUT

Offices and Agencies in Principal Cities • In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.

EVERDUR is a trade-mark of The American Brass Company, registered in the United States Patent Office.

THE WEATHER FOR OCTOBER, 1937

Plotted from records compiled for HEATING & VENTILATING by the U. S. Weather Bureau. Heavy curves (T), dry bulb temperatures in deg. F.; dotted lines (H), per cent relative humidity from readings at 8 a.m., noon, and 8 p.m. Light lines (W), wind velocity in m.p.h. Arrows indicate wind direction at maximum velocity, north being arrow pointing up, etc.; S—clear; PC—partly cloudy; C—cloudy; R—rain; Sn—snow.


Warmest Day 89° on the 1st
Greatest Daily Range 36° on the 25th
Least Daily Range 5° on the 22nd
Coldest Day 32° on the 14th
Warmest Day 84° on the 1st
Greatest Daily Range 31° on the 29th
Least Daily Range 4° on the 2nd
Coldest Day 30° on the 14th
Warmest Day 85° on the 6th
Least Daily Range 6° on the 27th
Greatest Daily Range 32° on the 1st
Coldest Day 27° on the 16th
Greatest Daily Range 26° on the 7th
Least Daily Range 4° on the 24th
Warmest Day 76° on the 17th
Coldest Day 35° on the 15th
Greatest Daily Range 26° on the 12th
Coldest Day 32° on the 17th
Least Daily Range 4° on the 28th
Warmest Day 74° on the 5th
T
H
W
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Day of Month

St. Louis

Mean temp. for month, 57.0F; aver. wind velocity, 11.1 m.p.h.; prevailing direction of wind, W.

Chicago

Mean temp. for month, 51.2F; aver. wind velocity, 10.4 m.p.h.; prevailing direction of wind, NW.

Pittsburgh

Mean temp. for month, 50.1F; aver. wind velocity, 11.3 m.p.h.; prevailing direction of wind, NW.

New York

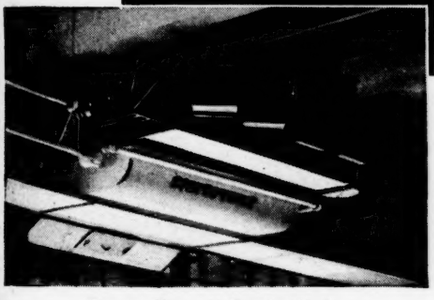
Mean temp. for month, 54.6F; aver. wind velocity, 15.9 m.p.h.; prevailing direction of wind, NW.

Boston

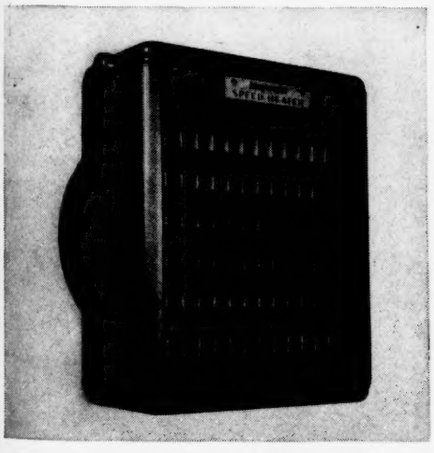
Mean temp. for month, 52.6F; aver. wind velocity, 12.1 m.p.h.; prevailing direction of wind, S.

Why STURTEVANT REXVANE HEATERS LICK THE TOUGH HEATING JOBS

... and Save Money!



Rexvane Heater Ceiling Installation



Sturtevant Speed Heaters are available in ten sizes up to 329,000 B.T.U. (standard rating). Distributed by Crane Co.

ADEQUATE CAPACITIES—a wide range of sizes up to 1,421,000 (standard rating). For floor, wall or ceiling installation.

EVEN HEAT DISTRIBUTION—assured by Hyperbolic Design outlets which discharge heated air smoothly and for greater distances.

MOTOR HORSEPOWER SAVING—effected by recently developed fan which handles large volumes of air with comparative quietness, *and with extremely low power requirements.*

TROUBLE-FREE HEATING ELEMENT—absolutely leakproof. Guaranteed for all steam pressures up to 200 pounds.

HEAT LOAD SAVINGS—effected with Thermadjust Control which balances the proportion of heated and unheated air during moderate heating periods.

Write for Sturtevant Rexvane Heater Catalog No. 395-1 containing full information.

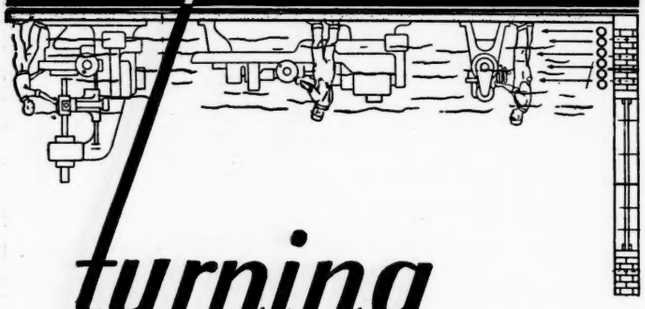
B. F. STURTEVANT COMPANY, HYDE PARK, BOSTON, MASS.
Branch Offices in 40 Other Cities . . . B. F. Sturtevant Co. of Canada, Ltd. — Galt, Toronto, Montreal

Sturtevant
REG. U. S. PAT. OFF.

Puts Air to Work

WORLD'S LARGEST MAKERS OF AIR HANDLING AND CONDITIONING EQUIPMENT

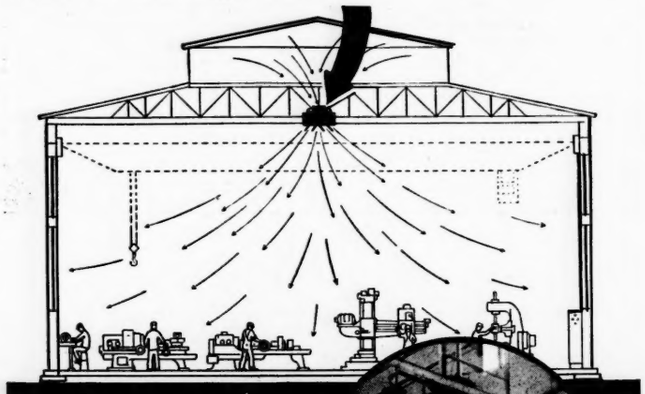
NO—THERE'S NOTHING WRONG WITH THIS PICTURE



turning

your plant upside down would be ONE WAY to heat your working area by making use of the heat that is wasted in the upper spaces—with your present heating system.

THE OTHER practical and inexpensive way is to install WING Featherweight Heaters.



WING *featherweight* UNIT HEATERS

"Floodlights of Heat"

Spread a uniform healthful temperature over the ENTIRE working area.

Send for interesting booklet "Wing Featherweight Unit Heaters".

L. J. WING MFG. CO.

158 W. 14th ST.

NEW YORK, N. Y.

Summer Degree-Hours—1937 vs. 1936

SINCE a number of cities have dry bulb temperatures over 85F in October, the yearly totals for 1937 appear somewhat late. The accompanying table gives the total number of degree-hours above 85F for the years 1937 and 1936. Only one city, New Orleans, showed an appreciable number of degree-hours in 1936 after November 1, so that for all practical purposes the number of degree-hours appearing in this table may be used as the summer totals.

These data on the summer degree-hours have been presented in this and preceding issues of HEATING & VENTILATING since there is some evidence that at least a part of the cooling load in air conditioning is proportional to the number of degree-hours the temperature is above 85F. It should be noted that the unit provides only for that part of the load which depends on the outdoor dry bulb temperature and does not show those fluctuations in the load due to high humidity, load from internal or solar heat or body heat losses.

SUMMER DEGREE-HOURS (85F BASE) FOR 1937 AND 1936

City	1937	1936
Baltimore	1543	2025
Birmingham	2803	3906
Bismarck	1660	4663
Boston	704	356
Buffalo	27	111
Chicago	652	1137
Cincinnati	1033	3937
Cleveland	165	710
Columbus	854	2797
Des Moines	2507	6560
Detroit	512	1879
Fort Wayne	542	2714
Grand Rapids	980	1901
Houston	4034	3797
Indianapolis	834	4432
Kansas City	5016	12399
Memphis	2061	4657
Milwaukee	694	1090
Minneapolis	1835	3017
New Orleans	2659†	3476‡
New York	500	560
Philadelphia	1003	1255
Pittsburgh	538	1262
Portland, Ore.	208	183
Richmond, Va.	1339	2167
St. Louis	2388	8361
San Diego	14	9
San Francisco	12	25
Savannah	2320	3507
Toledo	581	2064
Washington	1279	1945

†Up to Nov. 1, 1937.
‡Up to Nov. 1, 1936. The total for 1937 was 3491.

WITH THE MANUFACTURERS

The American Rolling Mill Co., Middletown, Ohio, has named *Murray B. Wilson* manager of its New York sales district. Mr. Wilson has been associated with Armco since 1923. He succeeds Cliff Spear who has been forced to curtail his activities because of ill health.

The Emerson Electric Mfg. Co., St. Louis, Mo., has named *Clarence Wittmer* national service manager. Mr. Wittmer assumes the position formerly occupied by W. A. Devlin, resigned.

Fedders Manufacturing Co., Inc., Buffalo, N. Y., has appointed *E. M. Donohue* factory representative of its heating division. Mr. Donohue will serve the Cleveland market, with headquarters at 1935 Euclid Ave.

J. A. Proctor

General Electric Co., Schenectady, N. Y., has appointed *J. A. Proctor* assistant manager of its air conditioning department at Bloomfield, N. J. For the past three years Mr. Proctor has been assistant to C. E. Wilson, G.E. vice-president.

Hancock Valve Div., Manning, Maxwell & Moore, Inc., Bridgeport, Conn., has added *Charles Velie* and *Raymond Heath* to its staff of field missionary men. Mr. Velie's headquarters will be in Chicago; Mr. Heath's in Dallas.

The Linde Air Products Co., New York, has moved its Indianapolis district office into new headquarters at *729 N. Pennsylvania St.* The new two-story building will also house the company's repair and service station.

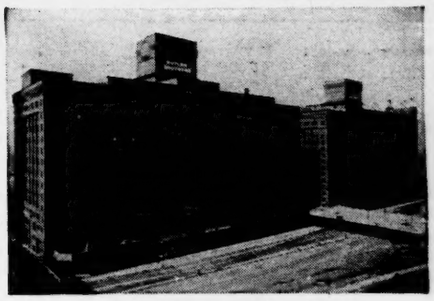
The Mueller Brass Co., Port Huron, Mich., has named the *Borg Warner Service Parts Co.*, 310 S. Michigan Ave., Chicago, as export representative of its refrigeration products. *Ray P. Johnson* is manager of the Borg Warner's refrigeration and heating department.

L. J. Mueller Furnace Co., Milwaukee, Wis., has appointed *J. G. Werner* Philadelphia manager, with headquarters at Delaware and Morris Streets. *Karl E. Kahley* has been named Pittsburgh manager with headquarters at 405 W. Warrington Ave.

National Manufacturing & Engineering Co., 628 E. Forest Ave., Detroit, Mich., has started production on forced air heating, ventilating and air conditioning units. These units will be manufactured for distributors under their own trade names as well as under the "Barton" trade mark. Units are being manufactured for coal, oil, gas, and stoker firing.

The C. F. Pease Co., Chicago, manufacturer of blueprinting machines, drafting room furniture, and photographic arc lamps, has moved into its new, modern administration building and plant at *2601 W. Irving Park Road*, Chicago.

Republic Steel Corp., Cleveland, Ohio, has announced five new distributors of its tubular products: *Bomar Gross, Inc.*, Jamaica, N. Y.; *Drake Supply Co.*, Los Angeles, Calif.; *Iowa Machinery & Supply Co.*, Des



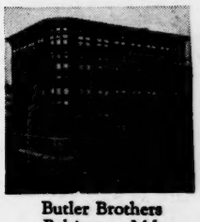
Butler Brothers, Chicago, Ill.

LEADING CHICAGO FIRM GETS IMPROVED HEATING

Famous Butler Brothers Complete Payment After One Season With Webster Moderator System

MEETS VARIED HEATING NEEDS

Chicago, Ill.—The heating installation in the great central warehouse and office building group of Butler Brothers Store was modernized during the early fall of 1935. The previously uncontrolled heating system was orificed throughout to balance distribution and placed under control of an 8-zone Webster EH Moderator System. This number of zones was necessary to provide for different conditions of occupancy and the needs of different tenants as well as the requirements of Butler Brothers own operations.



Butler Brothers
Baltimore, Md.

This modernization program, one of the largest central control heating installations ever made, was completed in a remarkably short time by William Lees, Inc., prominent Chicago heating contractors. The fall and winter of 1935-36 served as a period for adjustment and perfection of operating procedure.

An idea of the savings possibilities is afforded by the record for five months during this adjustment period, from January to May, 1936, inclusive. During this period a measured savings of 420.16 tons, equivalent to $1218.46, was attained.

Under the contract covering the modernization program Butler Brothers reserved the option to permit payment to be made out of current monthly savings as made, or to complete payment for cash. It is significant that with this privilege Butler Prothers elected to complete payment for cash early in the second season of cperation.

It is even more significant that a similar modernization program has since been carried out in the Baltimore warehouse building of Butler Brothers.

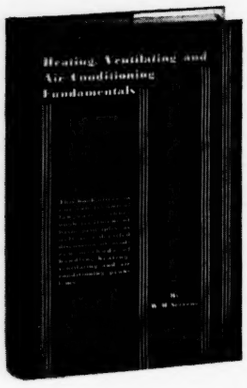
These before-and-afrer facts point the way to maximum comfort and economy in heating new buildings as well as in modernization of existing installations. Consult your architect, engineer or heating contractor. Or address

WARREN WEBSTER & CO., Camden, N. J.
Pioneers of the Vacuum System of Steam Heating
Representatives in 60 principal U.S. Cities—Est. 1888

WEBSTER MODERATOR CONTROL "Control by the weather"

SEE WEBSTER EXHIBIT
HEATING & VENTILATING EXPOSITION
New York
January 24 to 28, 1938

Published October 1937



A thorough treatment of principles and practice . . .

HEATING, VENTILATING AND AIR CONDITIONING FUNDAMENTALS

By WILLIAM H. SEVERNS

Professor of Mechanical Engineering
University of Illinois

This book discusses the latest developments in the field, in not too technical language. Essentially practical in nature, it offers the busy engineer a ready means of reviewing basic principles as well as a detailed discussion of present-day methods of handling heating, ventilating and air conditioning problems.

Covers many important topics

Properties of saturated steam
Piping design for forced-circulation hot-water systems
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Overall coefficient of heat transmission
How to test heating boilers
Factors affecting boiler selection
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Kindly send me a copy of Severns' HEATING, VENTILATING AND AIR CONDITIONING FUNDAMENTALS, on ten days' approval. If at the end of that time I decide to keep the book, I will remit $4.00 plus postage; otherwise I will return it postpaid.

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HV-12/37

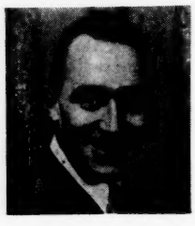
Moines, Iowa; *Wilkins Pipe & Supply Co.*, Peoria, Ill., and *Woodmanse Mfg. Co.*, Freeport, Ill.

The H. B. Smith Co., Westfield, Mass., is consolidating the manufacturing facilities of its Numbers 1 and 2 plants. New equipment is being installed and new structures for housing the machine shop are being added to Plant No. 1. Plant 2 will be completely disposed of, including surplus machinery, land and structures.

Torrington Manufacturing Co., Torrington, Conn., has appointed *Walter L. Upson*, professor of electrical engineering in Washington University, St. Louis, head of the company's research. Professor Upson, who will assume his new duties January 1, 1938, will give especial attention to fans and air impellers. He served as consulting engineer for Torrington for the past several years and is the inventor of its Airistocrat fan.

H. A. Thrush & Co., Peru, Ind., has named *Blaine H. Moke* direct factory sales representative in the St. Louis territory, with headquarters at 3863 W. Pine Blvd.

Timken Silent Automatic Division, The Timken-Detroit Axle Co., Detroit, Mich., has named *J. C. Johnson* district sales manager for the territory embracing Indiana, eastern Illinois, and western Ohio. *J. A. MacDougall* has been appointed office manager of the company's Philadelphia factory branch.



R. J. Reed

Titusville Iron Works Division of Struthers Wells-Titusville Corporation of Warren and Titusville, Pa., has appointed *R. J. Reed* manager of its division. Mr. Reed has been associated with this division for more than ten years. He has been succeeded in his previous position of sales manager by *Douglas E. Penning*.

The Trane Co., La Crosse, Wis., held a demonstration of its new projection unit heater for the company's 250 plant engineers, and factory maintenance men from Michigan and Upper Ohio and Indiana, in the Detroit National Guard Armory. One of the units was installed in the Armory 35 ft. above the floor, providing a practical demonstration for the gathering. A no-speech dinner at the Barlum Hotel followed the demonstration.

Westinghouse Electric & Manufacturing Company's recently announced home air conditioning activities at Mansfield, Ohio, will be directed by *William H Stangle*. Long identified with air conditioning merchandising and building activities, Mr. Stangle joined Westinghouse a year ago. Since that time he has been conducting a survey of the home air conditioning market, the result of which Westinghouse is using as the basis of its entrance into the residential air conditioning field.

W. H. Stangle

L. J. Wing Mfg. Co., New York, has made extensive additions to the main factory building of its Newark, N. J., plant, thereby increasing its production capacity.

NEW CATALOGS

(Unless otherwise indicated the publishers of catalogs will supply copies on request without charge.)

A. M. Byers Co., Pittsburgh, Pa. A standard-size, 32-page bulletin entitled "101 Uses For Wrought Iron." Bulletin consists mainly of pictures illustrating the use of wrought iron. Each picture represents a different use for wrought iron—a use where definite evidence was available that wrought iron would last longer and cost less to maintain than other materials. Some illustrations represent new construction, some are maintenance replacements, and still others show where wrought iron has been embodied in a finished product to increase its salability.

Julien P. Friez & Sons, Inc., Baltimore, Md. An eight-page, condensed catalog entitled Bulletin K of air conditioning products. Contains illustrations, brief descriptions, and list prices of the complete range of Friez instruments for automatic controlling, indicating, recording, testing and measuring of air conditions.

Hoffman Specialty Co., Inc., Waterbury, Conn. A 32-page booklet containing the results of a survey of residential heating and air conditioning trends, systems and costs. A typical home has been selected and a comparison is made between the costs of heating this home with a forced warm air heating system and a one-pipe vacuum steam system with an air conditioning unit.

The Trane Co., La Crosse, Wis. A 36-page, standard-size bulletin, No. V260, on Trane heating specialties. Catalog is conveniently arranged with descriptions of all Trane heating specialties. Also has data on vapor heating systems, split systems, vacuum and heat loss calculations. Typical piping connections are described.

Webster Tallmadge & Co., Inc., New York, N. Y. A standard-size, 24-page catalog on the Tallmadge zoned controlled heating systems. Discusses the features of this system, tells how it operates, and gives information on zoning, such as zoning for exposure, for occupancy, for altitude and size and location of zones. Also gives performance data on two typical applications. Five types of Tallmadge systems are described.

COMING EVENTS

DECEMBER 6-10, 1937. Annual Meeting, American Society of Mechanical Engineers, New York.

DECEMBER 6-11, 1937. 16th Exposition of Chemical Industries, Grand Central Palace, New York.

DECEMBER 27-28, 1937. Drying and Air Conditioning. Subject of 4th Annual Chemical Engineering Symposium of the American Chemical Society, University of Pennsylvania, Philadelphia.

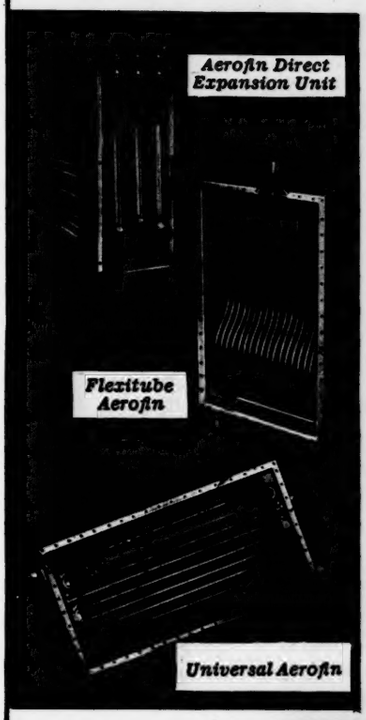
JANUARY 24-26, 1938. Winter Convention, National Warm Air Heating and Air Conditioning Association, Hotel Roosevelt, New York.

JANUARY 24-28, 1938. 5th Internatonal Heating and Ventilating Exposition, Grand Central Palace, New York. Charles F. Roth, Grand Central Palace, New York.

JANUARY 24-28, 1938. 44th Annual Meeting, American Society of Heating and Ventilating Engineers, New York.

JANUARY 25-27, 1938. 33rd Annual Meeting, American Society of Refrigerating Engineers, Hotel Roosevelt, New York.

AEROFIN
Heat-Exchange Surface



AEROFIN standardized fan system heat exchange surface has been engineered to meet the most rigid specifications and the most exacting demands of those who expect unequaled service.

The experience that has gone into Aerofin's design and manufacture and the completeness of its line for every cooling and heating requirement, has made it the preferred equipment with consulting engineers, architects and contractors.

The confidence which they have reposed in Aerofin has always been justified. Why?

Because Aerofin's record of satisfactory performance in thousands of installations, both large and small, in such famous public buildings as the United States Capitol and many others, is definite evidence of its superiority.

Investigate the merits of Aerofin. Let us tell you about the special features that have been incorporated in Aerofin which makes it outstanding.

Write today for complete engineering information or ask any of our district offices for technical assistance. No obligation.

Direct Expansion Unit with Centrifugal Header
Cleanable Tube Unit with Removable Header
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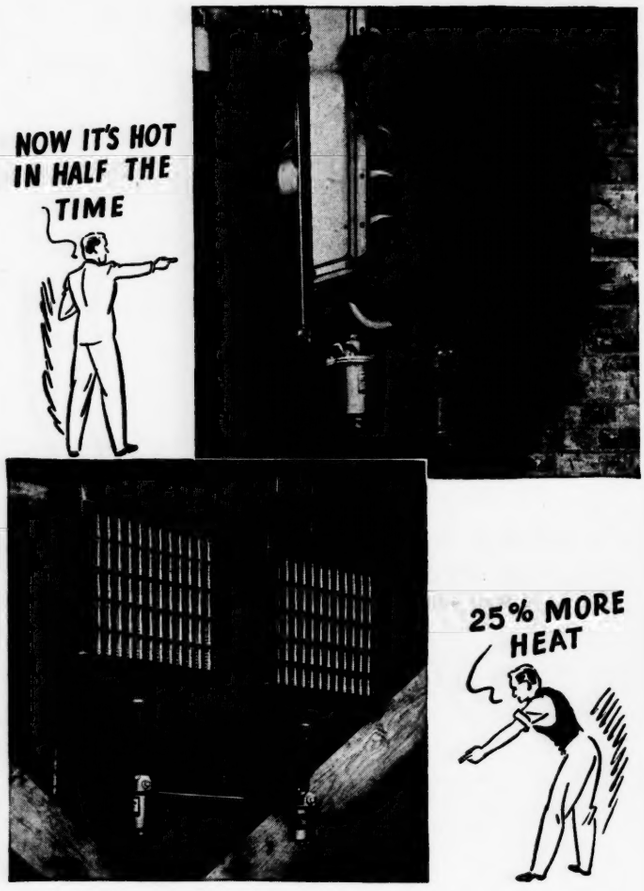
SYRACUSE, N. Y.

How to get More Heat *and* Instant Heat



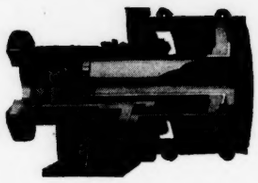
TO get more heat from your heating system you must have a steam trap that keeps the system dry at all times. To get instant heat you must have instantaneous removal of entrained air.

Both of these important functions are performed to perfection by Anderson Super-Silvertop steam traps. In a recent test, changing to an Anderson Super-Silvertop trap with Thermal Air Eliminator increased heat output 25%. In another test a unit heater became hot in half the time when a Super-Silvertop trap was used.

Know more about this modern, engineered steam trap—it can save you heating dollars and cut down the heating-up period. Find out now what this extra value trap can do for you. Send for complete information about Anderson Super-Silvertop, the only complete steam trap.

THE V. D. ANDERSON CO.
1943 WEST 96TH STREET • CLEVELAND, OHIO

ADSCO INTERNALLY-EXTERNALLY GUIDED JOINT



The Most

COMPLETELY GUIDED
Slip Type Expansion Joint

Both ends of slip guided continuously and independently by an internal guide ring and an external guide in hood. Only packing touches polished slip surface. No metal to metal contact between body and slip. Slip can not pull out of body.

Hood protects against dirt and accidents to the slip surface. Two-piece hood with openings for adjustment without removal of hood.

Write for Bulletin No. 35-20V

Some Recent Installations

BUREAU OF PRINTING & ENGRAV. Washington, D. C.
CALVERT DISTILLING CO. Relay, Md.
ILLINOIS BELL TELEPHONE CO. Chicago, Ill.
MATTHEWS COTTON MILLS Greenwood, S. C.
McKINNON INDUSTRIES, LTD. St. Catherines, Ont.
ROCHESTER GAS & ELEC. CO. Rochester, N. Y.
SEA VIEW HOSPITAL Staten Island, N. Y.
UNION PACIFIC R. R. Omaha, Nebr.
U. S. ARMY BARRACKS Plattsburg, N. Y.
U. S. NAVAL ACADEMY Annapolis, Md.
U. S. NAVAL AIR STATION Pensacola, Fla.
YPSILANTI STATE HOSPITAL Ypsilanti, Mich.

AMERICAN DISTRICT STEAM COMPANY
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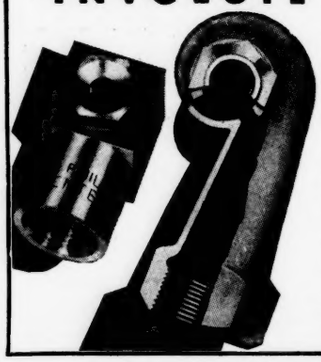
OVER FIFTY YEARS IN BUSINESS

YARWAY INVOLUTE NOZZLES



The preference for trouble-free air washing service — because there are no internal parts or vanes to wear or clog. Proven through many years of service in water cooling and air conditioning installations totaling more than 5 million g. p. m.

Made in sizes and types for all requirements. Ask for Bulletin N-615.

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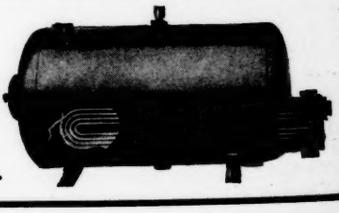
Patterson Hot Water Heaters

They are guaranteed to supply all the hot water required, as hot as required, and as quickly as required. Thousands in use. Backed by over 50 years' experience.

Supplied with shells of pure copper, Everdur, steel with copper lining, steel, stainless steel, and nickel clad steel. Write for catalog.



The Patterson-Kelley Co., Inc.
105 Burson St.
East Stroudsburg, Pa.

TABLE 1

HEAT ADDED TO STILL AIR AT 70° BY HOT PIPE WITHOUT PIPE COVERING

Nominal Pipe Diam. (Inches)	Temperature of Hot Substance (Usually Steam or Hot Water) in Pipe															
	100°		120°		150°		180°		210°		240°		270°		300°	
	Iron and Steel	Copper Tubing	Iron and Steel	Copper Tubing	Iron and Steel	Copper Tubing	Iron and Steel	Copper Tubing	Iron and Steel	Copper Tubing	Iron and Steel	Copper Tubing	Iron and Steel	Copper Tubing	Iron and Steel	Copper Tubing
⅛	14.5	8.5	25.0	14.9	41.9	25.6	61.5	37.8	83.4	51.5	151.8	65.5	134.0	81.5	163.0	98.5
¼	17.5	11.2	30.0	19.8	51.2	33.9	75.4	50.0	102.5	68.0	132.0	87.1	164.0	108.0	200.0	131.0
½	22.0	14.2	37.4	24.8	63.5	42.5	94.0	62.8	127.0	84.8	163.0	108.8	202.0	135.5	248.0	164.0
¾	27.0	17.0	46.0	29.6	78.0	50.8	114.0	74.5	158.0	101.5	200.0	130.5	249.0	161.0	304.0	196.0
1	31.0	19.8	52.2	34.3	88.4	58.8	129.0	86.4	176.0	117.5	228.0	156.0	284.0	187.0	344.0	228.0
1¼	38.0	25.4	64.2	44.2	108.0	74.1	159.0	111.2	208.0	150.0	277.0	190.5	347.0	241.0	423.0	292.0
1½	45.0	30.6	76.5	52.8	129.0	90.5	189.0	134.0	257.0	180.0	332.0	232.0	414.0	288.0	505.0	350.0
2	54.0	35.9	92.0	63.0	155.0	106.0	228.0	156.0	306.0	211.0	399.0	272.0	500.0	338.0	606.0	411.0
2½	61.0	41.0	104.0	71.0	175.0	121.0	256.0	178.0	339.0	242.0	450.0	311.0	566.0	386.0	685.0	497.0
3	69.0	46.2	116.0	79.5	196.0	131.0	286.0	199.7	394.0	271.0	502.0	349.0	625.0	432.0	765.0	526.0
3½	83.0	56.3	141.0	96.5	237.0	165.0	348.0	242.0	474.0	329.0	611.0	424.0	762.0	525.0	932.0	640.0
4	98.0	66.5	166.0	114.0	280.0	195.0	412.0	286.0	557.0	389.0	720.0	500.0	890.0	623.0	1095.0	759.0
5	127.0	—	213.0	—	358.0	—	524.0	—	712.0	—	918.0	—	1148.0	—	1400.0	—
6	156.0	—	262.0	—	440.0	—	648.0	—	875.0	—	1128.0	—	1410.0	—	1728.0	—
8	185.0	—	307.0	—	523.0	—	755.0	—	1020.0	—	1327.0	—	1652.0	—	2020.0	—
10																
12																

Figures are B.t.u. per hour per linear foot.

DIMENSIONS OF STANDARD IRON AND STEEL PIPE

Nominal Pipe Diam. (Inches)	Outside Diam. (Inches)	Sq. Ft. Area Per Linear Foot (Outside)	Nominal Pipe Diam. (Inches)	Outside Diam. (Inches)	Sq. Ft. Area Per Linear Foot (Outside)
⅛	0.840	0.22	3½	4.00	1.047
¼	1.050	0.275	4	4.50	1.178
½	1.315	0.344	4½	5.00	1.306
¾	1.660	0.435	5	5.563	1.455
1	1.900	0.498	6	6.625	1.734
1¼	2.375	0.622	8	8.625	2.257
1½	2.875	0.753	10	10.75	2.813
2	3.50	0.917	12	12.75	3.338

DIMENSIONS OF COPPER TUBING

Nominal Pipe Diam. (Inches)	Outside Diam. (Inches)	Sq. Ft. Area Per Linear Foot (Outside)	Nominal Pipe Diam. (Inches)	Outside Diam. (Inches)	Sq. Ft. Area Per Linear Foot (Outside)
⅛	0.625	0.166	2½	2.625	0.687
¼	0.875	0.229	3	3.125	0.82
½	1.125	0.295	3½	3.625	0.95
¾	1.375	0.360	4	4.125	1.08
1	1.625	0.425	5	5.125	1.34
1¼	2.125	0.560	6	6.125	1.61
1½					
2					

Published by Heating & Ventilating, 148 Lafayette St., New York.
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HEAT LOADS OF UNINSULATED HOT AND COLD SURFACES

Frequently, the air conditioning estimator has to take into account the heat loss or heat gain from or to hot or cold uninsulated surfaces located in the space to be conditioned. To help him to estimate with reasonable accuracy the magnitude of these heat quantities is the purpose of this data sheet.

It is agreed that in the case of either hot or cold surfaces, heat is transferred by the processes of convection and radiation, and for practical purposes the heat quantities involved can be estimated if the heat transferred by these two methods can be found and totaled. The problem of estimating heat quantities thus reduces itself to finding ways of calculating the radiated and convected heat. Radiated heat can be calculated by the formula of Stefan-Boltzmann. The formula is:

$$H_r = 0.1723 \times e \left(\frac{T_1}{100}\right)^4 - \left(\frac{T_2}{100}\right)^4 \quad \ldots\ldots (1)$$

in which

H_r = *radiated heat transferred in B.t.u. per sq. ft. per hr.,*
T_1 = *absolute temperature of warmer body,*
T_2 = *absolute temperature of colder body,*
e = *the effective emissivity of both bodies.*

At temperatures in the vicinity of those frequently encountered in air conditioning work, the values of e for many types of surfaces have been determined by Heilman. Some of the values are shown in Table A.

A point in using this formula which does not seem clear to many persons is that the values of e as reported by investigation and as listed in Table A are not always suitable for use at once in formula (1). It should be noted that e in the formula is defined as "effective emissivity" of both bodies concerned in the heat transfer. Where the "effective emissivity" of both bodies is the same as that of the hot body then e from the table can be used at once. Fortunately, in the usual case of pipes carrying hot or cold substances in the air of an ordinary room, this condition prevails and the radiation heat for this condition is closely estimated by using e equal to 0.90 to 0.94. Where large ducts carry air through a small room, however, this condition does not prevail and in such cases the results obtained by using the formula may be greatly in error if the wrong selection of the value of e is made.

The convection heat can be calculated by the use of Rice-Heilman formula which follows:

$$H_c = C \left(\frac{1}{D}\right)^{0.2} \left(\frac{1}{T_{av}}\right)^{0.181} \left(t_s - t_a\right)^{1.266} \quad \ldots (2)$$

TABLE A

	Temperature	
	100F	400F
Galvanized Iron		
Bright	0.44	0.17
Tarnished	0.53	0.53
Copper		
Bright	0.07	0.11
Tarnished	0.43	0.48
Aluminum Foil	0.06	—

in which

H_c = *convection heat transferred, B.t.u. per sq. ft. per hr.,*
C = *a constant whose value depends on the shape of the solid. For a horizontal cylinder such as pipe, $C = 1.016$; for a vertical plate, $C = 1.394$; for horizontal plates warmer than the surrounding air and facing upward, $C = 1.79$; for such a plate facing downward, $C = 0.89$,*
D = *diameter of pipe or circular duct, in.,*
T_{av} = *average temperature of solid surface and surrounding air, F.*
T_s = *temperature of surface of solid,*
T_a = *temperature of surrounding air.*

Table 1, which appears on the other side of this sheet, gives values of the heat transfer to still air at 70F by bare iron and steel pipes and copper tubing. This table was computed from formulas (1) and (2) and illustrates how these formulas can be used in solving practical problems. In the table the heat quantity shown is per foot of pipe length. The quantities shown are for the air at 70F but can be used without serious errors for estimating purposes from 60F to 80F.

In the cases where cold substances flow through pipes in still air, the data available are not as complete as they are for hot substances. By using the above formulas, however, the estimator can expect to get reasonably close estimates. The trouble in determining the heat flow to cold surfaces lies in the fact that the estimator has to solve the equation each time he wishes to find a heat quantity. This can be done by using a value from 0.90 to 0.94 for e for iron and steel pipes and of 0.57 for copper tubing in formula (1) and a value of C of 1.1016 in formula (2).

Where sheet metal ducts carry either hot or cold air through rooms which are at ordinary temperatures, the heat quantities may be estimated by applying formulas (1) and (2) as necessary. Care must be taken, however, in evaluating C in formula (2). There is some evidence that for ordinary rectangular ducts, the value of C should be fixed at 1.394.

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HEAT ADDED TO STILL AIR AT 70° BY HOT PIPES COVERED WITH PIPE INSULATION OF THICKNESS COMMONLY USED

Nominal Pipe Diam. (Inches)	Temperature of Hot Substance (Usually Steam or Hot Water) in Pipe															
	100°		120°		150°		180°		210°		240°		270°		300°	
	85% Magnesia	4-Ply Corr. Asb.	85% Magnesia	4-Ply Corr. Asb.	85% Magnesia	4-Ply Corr. Asb.	85% Magnesia	4-Ply Corr. Asb.	85% Magnesia	4-Ply Corr. Asb.	85% Magnesia	4-Ply Corr. Asb.	85% Magnesia	4-Ply Corr. Asb.	85% Magnesia	4-Ply Corr. Asb.
½	4.9	5.8	8.2	9.8	13.2	16.2	18.5	23.0	23.8	30.2	29.4	37.6	34.8	45.7	40.5	53.8
¾	5.5	6.5	9.2	11.0	15.0	18.2	20.8	26.0	26.7	34.0	33.0	42.5	39.3	51.6	45.6	60.8
1	6.3	7.4	10.5	12.6	17.1	20.2	23.7	29.6	30.6	38.7	39.0	48.3	45.4	58.9	51.9	69.4
1¼	7.2	8.6	12.2	14.6	19.8	24.1	27.6	34.2	35.6	45.0	43.8	56.0	51.2	68.2	60.6	80.5
1½	7.9	9.3	13.2	15.8	21.0	26.2	30.0	37.1	38.6	48.7	47.5	60.8	56.4	74.0	65.4	87.3
2	9.2	10.8	15.6	18.5	25.2	30.6	35.2	43.5	45.2	57.0	55.5	71.5	66.2	87.0	77.0	102.5
2½	10.6	12.5	17.8	21.3	29.0	35.2	40.3	50.2	52.0	65.8	64.0	82.0	76.2	99.7	88.5	117.5
3	12.4	14.6	20.8	24.9	33.7	41.2	47.0	53.5	61.0	76.9	75.0	96.0	89.2	116.5	103.5	137.1
3½	13.7	16.2	23.1	27.6	37.4	47.7	52.0	64.6	67.1	84.7	82.5	103.5	96.0	127.8	109.5	152.0
4	15.8	17.7	25.2	30.2	41.0	50.0	57.1	71.0	73.5	93.2	90.5	116.0	107.7	141.5	125.0	167.0
5	17.8	20.9	31.0	38.2	48.5	59.0	67.5	83.7	86.6	109.8	107.0	137.0	97.0	135.0	112.0	150.0
6	20.7	24.4	34.8	41.7	56.5	69.0	78.8	97.5	102.0	128.5	125.0	161.0	112.5	147.0	131.0	174.0
8	26.0	30.6	43.5	52.0	70.5	86.0	98.5	122.5	128.0	160.5	156.0	200.0	138.0	181.0	161.0	215.0
10	31.4	36.8	52.8	62.8	85.5	104.0	119.0	147.1	154.0	193.2	189.0	242.0	166.0	216.2	193.0	256.2
12	36.8	43.0	62.0	73.5	100.0	122.0	137.5	172.5	179.0	226.0	221.0	284.0	194.0	254.0	223.0	300.0

Figures are B.t.u. per hour per linear foot of Standard Pipe. Insulation is one inch thickness, except for temperatures of 270° and 300° with pipe sizes of 5" to 12", where it is 1½" thick. Table is computed for horizontal pipe but may be used for estimating purposes if pipe is installed vertical.

Thickness of Pipe Insulation Commonly Used on Hot Pipes Indoors.

One Inch Thickness on all pipe sizes with temperature from 100° to 267° (25 lb. gage pressure, steam).

One and One-Half Inches on pipes 4" or larger at temperatures of 267° to 338° (25 to 100 lb. steam), but one inch thick on pipes smaller than 4" at these temperatures.

For Pipe Insulations Not Listed in the Table, Multiply the Tabular Figure for 4-Ply per Inch Asbestos by the Following:

Type Insulation	Temperature of Hot Substance							
	100°	120°	150°	180°	210°	240°	270°	300°
Corrugated Asbestos Eight Ply per Inch	0.905	0.90	0.89	0.88	0.875	0.87	0.865	0.86
Laminated Asbestos 30 to 40 Laminations per Inch	0.685	0.68	0.675	0.67	0.665	0.66	0.655	0.65
20 Laminations per Inch	1.03	1.02	1.01	0.99	0.98	0.97	0.955	0.94
Rock Wool	0.72	0.71	0.70	0.695	0.69	0.685	0.68	0.67

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HEAT LOADS OF HOT INSULATED PIPES

Even though pipes carrying steam or hot water through air conditioned rooms are insulated, the heat given off by them is nearly always too large to be neglected in computing the heat load of the area. The table which appears on the other side of this sheet has been prepared to make it easier for the estimator to determine quickly just how much heat is added by such surfaces to rooms which are to be heated or cooled. The values for the heat quantities shown are per foot of pipe length and while they are for air at 70F, they can be used without serious error for estimating purposes from 60 to 80F.

In the upper part of the table appear the heat quantities for pipe insulated with either 85% magnesia or four-ply corrugated asbestos for temperatures from 100F to 300F. These quantities are in B.t.u. per linear foot per hour and are computed for pipes in a horizontal position. For estimating purposes, however, the same values may also be used for vertical pipes without serious error.

The heat quantities from pipe insulated with eight-ply per inch corrugated asbestos, laminated asbestos with from 20 to 40 laminations per inch, or rockwool can be estimated by using the multiplying factors given in the lower part of the table. These factors when multiplied by the figures for four-ply per inch asbestos appearing in the upper part of the table will give the heat added to the air by pipes covered with these other insulations.

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TIME SAVING SUMMER COOLING ESTIMATES

TABLE 1.

APPROXIMATE HEAT LOADS IN SUMMER IN VARIOUS TYPES OF SMALL BUILDINGS

PERSONAL SERVICE SHOPS

Floor Space: Allow one chair per 90 sq. ft. of floor space for barber shops; one chair per 100 sq. ft. for beauty shops.

Hair Dryers: Allow 500 B.t.u. per hr. for each hair dryer.

Hot Water: Allow 200 B.t.u. per hr. per chair sensible heat, and 400 B.t.u. per hr. per chair latent heat.

HEAT LOAD PER OPERATOR'S CHAIR (B.T.U. PER HR.)

	10° COOLING	15° COOLING
Sensible heat	3000	3800
Latent heat	1000	1200
Total heat	4000	5000

SMALL PRIVATE OFFICES

HEAT LOAD PER CU. FT. OF COOLED SPACE (B.T.U. PER HR.)

S = SENSIBLE HEAT
T = TOTAL HEAT

	10° COOLING		15° COOLING	
	S	T	S	T
Surrounding Space Uncooled				
Top Floor				
Two exposures	5¾	7	7	8¾
One exposure	4½	5¾	5¾	7¼
One exposure, best conditions	2½	3½	3½	4¾
Intermediate Floor				
Two exposures	3	4	4	5¼
One exposure	2½	3¼	3¼	4¼
One exposure, best conditions	1¾	2½	2½	3½
Adjacent Floor Space Cooled				
Top Floor				
Two exposed walls	4¼	5½	5½	7
One exposed wall	3½	4½	4½	5½
One exposure, best conditions	2¾	3½	3½	4½
Intermediate Floor				
Two exposed walls	2½	3¼	3¼	4½
One exposed wall	1¾	2½	2½	3½
One exposure, best conditions	1½	2	2	2¾

RESTAURANTS

Floor Space: Allow 14 sq. ft. per customer chair.

No. of Occupants: Add employes to number of chairs.

Outside Air: Allow not less than 7 to 10 c.f.m. per chair.

Hot Food: Allow 30 B.t.u. sensible heat, and 30 B.t.u. per hr. latent heat, per meal served.

Coffee Urn: 1 burner, 10 gal., allow total heat of 12,000 B.t.u. per hr., of which 5,000 sensible and 7,000 latent. If fully ventilated and exhausted allow 2,500 B.t.u. per hr. sensible, no latent.

Steam Table: 1 burner, allow 1,500 B.t.u. per hr. of which 750 sensible and 750 latent. If fully ventilated and exhausted, allow 200 B.t.u. sensible, no latent.

Waffle Irons: Allow 75% of input rating. If fully ventilated allow 50% of input rating.

HEAT LOAD PER CHAIR (B.T.U. PER HR.)

Sensible heat	900
Latent heat	300
Total heat	1200

ROOMS IN RESIDENCES

ROOMS EXPOSED ON TWO OR THREE SIDES

HEAT LOAD PER CU. FT. OF COOLED SPACE (B.T.U. PER HR.)

S = Sensible heat
T = Total heat

	10° COOLING		15° COOLING	
	S	T	S	T
2nd floor room.	3	4	4	5½
1st floor room.	2½	3½	3½	5
Same, with surrounding rooms also cooled	2	2¾	3	4

SMALL THEATERS

Floor Space: Allow 7½ sq. ft. per seat.

Outside Air: Allow not less than 7½ to 10 c.f.m. of outside air per seat.

HEAT LOAD PER SEAT (B.T.U. PER HR.)

	10° COOLING	15° COOLING
Sensible heat	500	600
Total heat	800	900

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TIME SAVING SUMMER COOLING ESTIMATES

There is a definite need for short, approximate methods of estimating summer cooling loads, somewhat like those in use for winter estimating. It is much more difficult, however, to set up short summer cooling estimates than winter estimates because of the greater number of factors which must be taken into account. These factors include such variables as sun heat, body heat, heat from lights, food, fuel and heat from humidity in ventilation air. These factors vary so much from time to time and between the various building types that there is no clear indication of their relationship. There are, however, several simplifications which can be made to shorten the usual summer estimate.

In comfort work it is common to plan on cooling to either 10 or 15F. Many types of rooms require only 10F, while in others 15F cooling is desired. There is a question as to whether a greater lowering of the dry bulb than 15F should be considered even on the hottest days. Carpenter's rule which is used widely for winter estimating purposes can be set up to make it possible to quickly calculate the heat transmitted through walls, glass, and by filtration air by each of these temperature differences as follows:

For 10F cooling and one air change for filtration where

H = Quantity of heat estimated, B.t.u. per hr.
G = Area of glass exposed, sq. ft.
W = Area of wall exposed, sq. ft.
V = Volume or cubical contents of the room or building.

Then

$$H = 10\ G - 2.5\ W - 0.2\ V \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

For 15F cooling and one air change for filtration

$$H = 15\ G - 3.75\ W - 0.3\ V \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

While there are some short-cut rules for calculating sun heat by allowing a percentage of the transmitted heat, these rules vary so much in application that they are not repeated here. In the case of appliance heat, hot water heat, and heat from similar sources, there are no short cuts except as these are developed by experience.

In Table 1 are tabulated some suggestions as to allowances which may be made in certain classes of buildings. This table may be used to obtain an idea of what may be added to the quantities estimated by (1) and (2), or the heat load figures tabulated under each building type may be used without (1) or (2), if desired. Figures in Table 1 must naturally be used with care and discrimination. Enough experience has not accumulated behind them to remove elements of doubt.

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DRAWING SYMBOLS OF MECHANICAL EQUIPMENT FOR BUILDINGS

Heating and Ventilating

- Wall Radiator Plan
- Wall Radiator Elevation
- Pipe Coil Plan
- Pipe Coil Elevation
- Indirect Radiator Plan
- Indirect Radiator Elevation
- Diaphragm Valve
- Thermostat
- Radiator Trap Elevation
- Radiator Trap Plan
- Tube Radiator Plan
- Tube Radiator Elevation
- Lock and Shield Valve
- Reducing Valve
- Vanes
- Air Supply Outlet
- Exhaust Inlet
- Supply Duct, Section
- Exhaust Duct, Section
- Butterfly Damper Plan (or Elevation)
- Butterfly Damper Elevation (or Plan)
- Deflecting Damper Rectangular Pipe

Piping

- Steam
- Condensate
- Cold Water
- Hot Water
- Air
- Vacuum
- Gas
- Refrigerant
- Oil

Refrigeration and Air Conditioning

- Low Side Float
- High Side Float
- Thermostatic Expansion Valve
- Pressurestat with High Pressure Cut-Out
- Pressurestat
- Automatic Expansion Valve
- Hand Expansion Valve
- Gage
- Solenoid Valve
- A.C. Motor
- D.C. Motor
- Thermal Bulb
- Thermostat (Remote Bulb)
- Cooling Tower
- Evaporative Condenser
- Compressor
- Fuse — One Line / Complete
- Hand Shut-Off Valve
- Scale Trap
- Forced Convection Cooling Unit
- Disconnect Switch
- Drier
- Strainer
- Ice Making Unit
- Immersion Cooling Unit
- Heat Interchanger
- Pipe Coil
- Finned Type Cooling Unit, Natural Convection
- Evaporator Pressure Regulating Valve, Thermostatic Throttling Type
- Evaporator Pressure Regulating Valve, Snap-Action Valve
- Compressor Suction Pressure Limiting Valve, Throttling Type (COMP. SIDE)
- Evaporator Pressure Regulating Valve, Throttling Type (EVAP SIDE)
- Condensing Unit, Air Cooled
- Condensing Unit, Water Cooled

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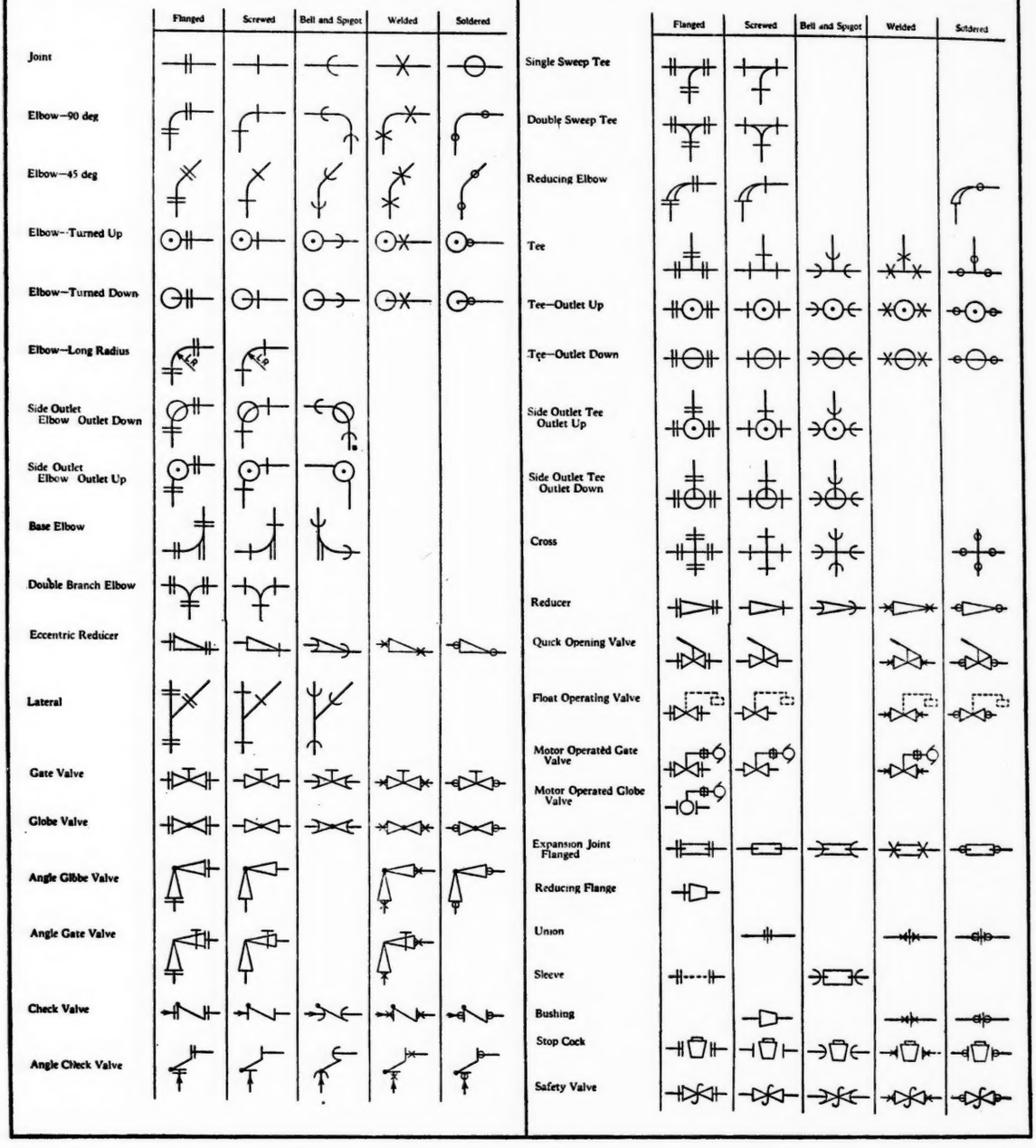
DRAWING SYMBOLS OF MECHANICAL EQUIPMENT FOR BUILDINGS

Pipe Fittings and Valves



The two tables which appear on this sheet present in compact form what is believed to represent current practice in the use of symbols for indicating various types of heating, ventilating, piping, refrigeration and air conditioning equipment used in buildings. The table on the other side of this sheet covers three different types of symbols, the first two on heating, ventilating and piping being those recently adopted by the American Standards Association and published as "American Standard Drawings and Drafting Room Practice—Graphical Symbols (A.S.A.-Z14.2-1935)." The symbols on refrigeration and air conditioning equipment, which make up section three of the table, are those adopted in August, 1936, by the refrigeration division of the National Electric Manufacturers Association, the Refrigerating Machinery Association, and the Air Conditioning Manufacturers Association. They are not claimed to be complete or final and may be added to from time to time. The above table, giving the standards for pipe fittings and valves, is also taken from the A.S.A.-Z14.2 Standards.

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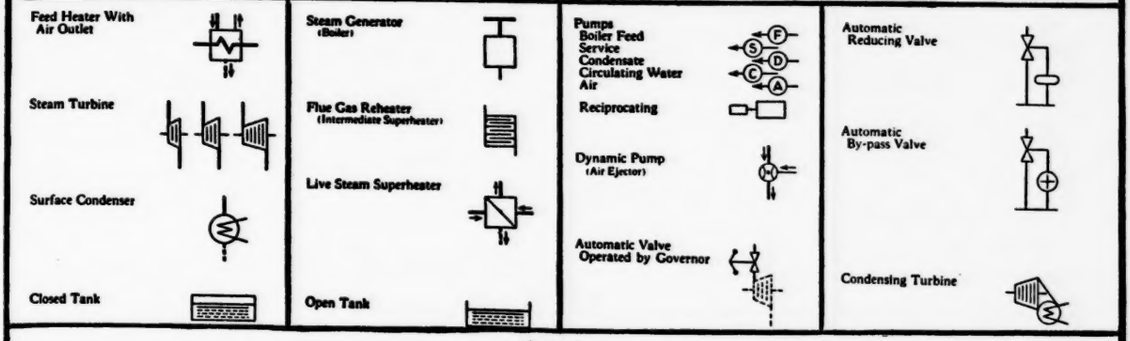
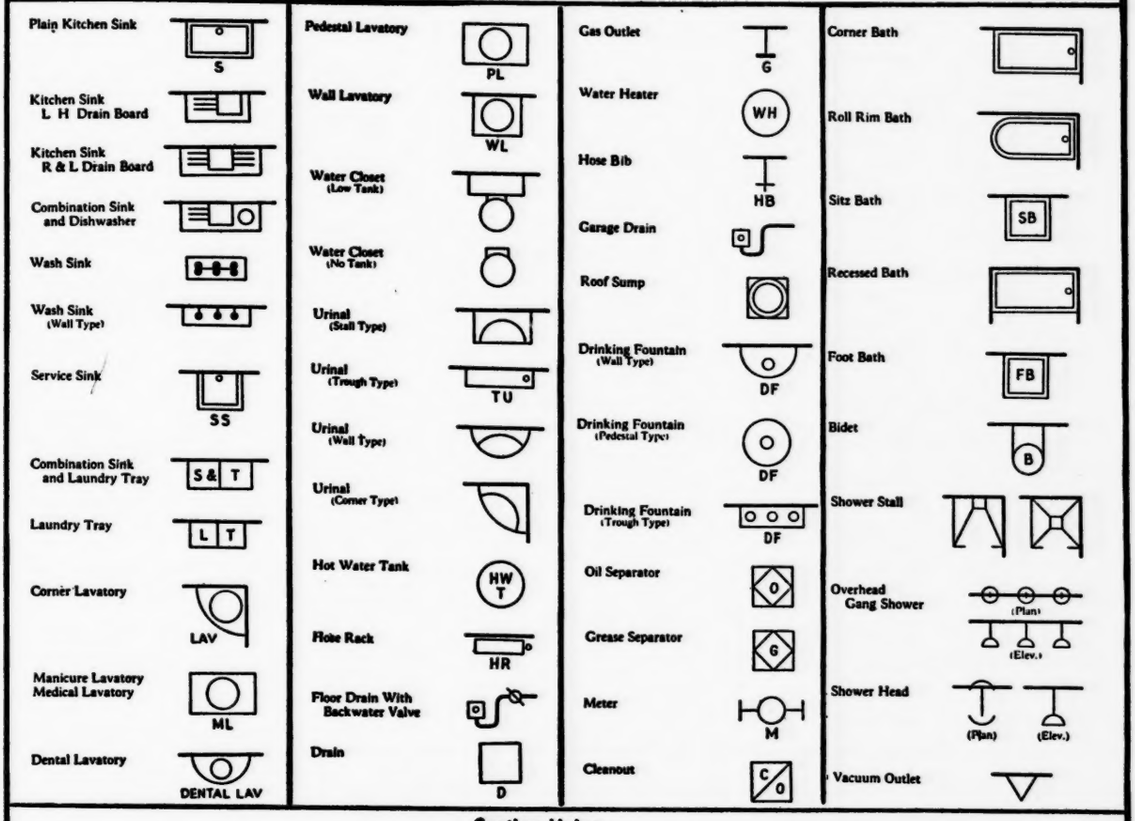
H & V's REFERENCE DATA—100

DRAWING SYMBOLS OF MECHANICAL EQUIPMENT FOR BUILDINGS

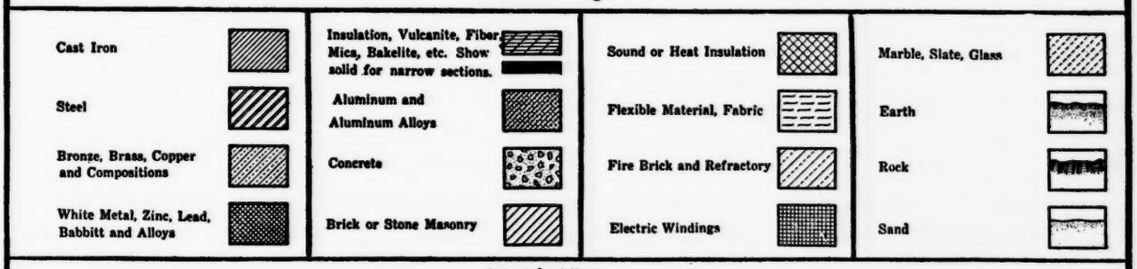
Heat Power Apparatus



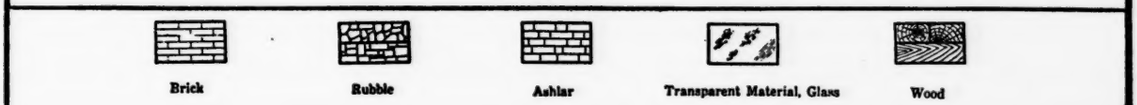
Plumbing



Section Lining



Outside Views



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H & V's REFERENCE DATA—101

DRAWING SYMBOLS OF MECHANICAL EQUIPMENT FOR BUILDINGS

Electrical Equipment of Buildings

- Ceiling Outlet
- Ceiling Outlet (Gas and Electric)
- Ceiling Lamp Receptacle—Specification to Describe Type such as Key, Keyless or Pull Chain
- Ceiling Outlet for Extensions
- Ceiling Fan Outlet
- Floor Outlet
- Drop Cord
- Wall Bracket
- Wall Bracket (Gas and Electric)
- Wall Outlet for Extensions
- Wall Fan Outlet
- Wall Lamp Receptacle—Specification to Describe Type such as Key, Keyless or Pull Chain.
- Single Convenience Outlet
- Double Convenience Outlet
- Junction Box
- Special Purpose Outlet—Lighting, Heating and Power as Described in Specification
- Special Purpose Outlet—Lighting, Heating and Power as Described in Specification
- Special Purpose Outlet—Lighting, Heating and Power as Described in Specification
- Exit Light
- Floor Elbow
- Floor Tee
- Pull Switch
- Local Switch—Single Pole
- Local Switch—Double Pole
- Local Switch—3 Way
- Local Switch—4 Way
- Automatic Door Switch
- Key Push Button Switch
- Electrolier Switch
- Push Button Switch and Pilot
- Remote Control Push Button Switch
- Tank Switch
- Motor
- Motor Controller
- Lighting Panel
- Power Panel
- Heating Panel
- Pull Box
- Cable Supporting Box
- Meter
- Transformer
- Branch Circuit, Run Concealed under Floor Above
- Branch Circuit, Run Exposed
- Branch Circuit, Run Concealed Under Floor
- Feeder Run, Concealed under Floor Above
- Feeder Run, Exposed
- Feeder Run, Concealed under Floor
- Pole Line
- Push Button
- Buzzer
- Bell
- Annunciator
- Interior Telephone
- Public Telephone
- Local Fire Alarm Gong
- City Fire Alarm Station
- Local Fire Alarm Station
- Fire Alarm Central Station
- Speaking Tube
- Nurse's Signal Plug
- Maid's Plug
- Horn Outlet
- District Messenger Call
- Clock (Secondary)
- Clock (Master)
- Time Stamp
- Electric Door Opener
- Watchman Station
- Watchman Central Station Detector
- Public Telephone—P. B. X. Switchboard
- Interior Telephone Central Switchboard
- Interconnection Cabinet
- Telephone Cabinet
- Telegraph Cabinet
- Special Outlet for Signal System as Described in Specification.
- Battery
- Signal Wires in Conduit Concealed Under Floor
- Signal Wires in Conduit Concealed under Floor Above
- This Character Marked on Tap Circuits Indicates 2 No. 14 Conductors in ½-in. Conduit (see note)
- 3 No. 14 Conductors in ½-in. Conduit
- 4 No. 14 Conductors in ¾-in. Conduit Unless Marked ½-in.
- 5 No. 14 Conductors in ¾-in. Conduit
- 6 No. 14 Conductors in 1-in. Conduit Unless Marked ¾-in.
- 7 No. 14 Conductors in 1-in. Conduit
- 8 No. 14 Conductors in 1-in. Conduit

The tables which appear on this data sheet present in compact form what is believed to represent current practice in the use of symbols for indicating various types of heat-power apparatus, plumbing, electrical equipment and the section linings and outside views of various materials. The first and second parts of the table on the opposite side of this sheet, entitled "Heat-Power Apparatus" and "Plumbing," have been taken from the American Standard Drawings and Drafting Room Practice—Graphical Symbols (A.S.A.-Z14.2-1935), while section three, on sectional lining and outside views, has been taken from the A.S.A. Recommended Practice for Drawings and Drafting Rooms (A.S.A.-Z14.1-1935). The above table shows the standard symbols for electrical equipment of buildings as adopted by the American Institute of Architects and the Association of Electragists-International.

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H & V's REFERENCE DATA—102

WINDOW CONDENSATION

TABLE 1.—OUTSIDE TEMPERATURES AT WHICH MOISTURE WILL DEPOSIT ON VARIOUS TYPE WINDOWS FOR DIFFERENT INSIDE TEMPERATURES AND RELATIVE HUMIDITIES

Inside Temperature, °F.	Inside Relative Humidity, %	Inside Dewpoint, °F.	Outside Temperature At Which Moisture Will Deposit—°F			
			Single Windows		Double Windows	
			Still Air	Wind	Still Air	Wind
60	10	6	**—48**	**—21**	**—156**	**—120**
	20	20	**—20**	**0**	**—100**	**—73**
	30	29	**—2**	**14**	**—64**	**—43**
	40	36	12	24	—36	—20
	50	41	22	31	—16	**—3**
	60	46	32	39	4	13
	70	50	40	45	20	27
	80	54	48	51	36	40
	90	57	54	55	48	50
	100	60	60	60	60	60
65	10	10	**—45**	**—17**	**—155**	**—118**
	20	24	**—17**	**4**	**—99**	**—72**
	30	33	1	17	—63	—41
	40	40	15	28	—35	—18
	50	46	27	37	—11	2
	60	51	37	44	9	18
	70	55	45	50	25	31
	80	59	53	56	41	45
	90	62	59	60	53	55
	100	65	65	65	65	65
70	10	13	**—44**	**—15**	**—158**	**—120**
	20	28	**—14**	**7**	**—98**	**—70**
	30	37	4	20	—62	—40
	40	45	20	33	—30	—13
	50	50	30	40	—10	3
	60	55	40	48	10	20
	70	60	50	55	30	37
	80	64	58	61	46	50
	90	67	64	65	58	60
	100	70	70	70	70	70
75	10	16	**—43**	**—14**	**—161**	**—122**
	20	31	**—13**	**9**	**—101**	**—72**
	30	41	7	24	—61	—38
	40	49	23	36	—29	—11
	50	55	35	45	**—5**	8
	60	60	45	53	15	25
	70	65	55	60	35	42
	80	68	61	65	47	52
	90	72	69	70	63	65
	100	75	75	75	75	75
80	10	20	**—40**	**—10**	**—160**	**—120**
	20	35	—10	13	—100	—70
	30	46	12	29	—56	—33
	40	53	26	40	—28	—10
	50	60	40	50	0	13
	60	65	50	58	20	30
	70	69	58	64	36	43
	80	73	66	70	52	57
	90	77	74	75	68	70
	100	80	80	80	80	80

NOTE: If the answer, appearing in any of the last four columns, is printed in bold-face type, the dewpoint temperature is below 32F and the condensation on the window will be in the form of frost.

Example: In a room with a temperature of 70F and a relative humidity of 50% and with single windows, at what outside temperature with wind will moisture be deposited on the window?

Solution: Referring to Table 1, find the figure 50 in the second column of the division marked "70F" in the first column. In the fifth column, which relates to single windows with wind, we find that moisture will be deposited at 40F.

Example: With a room temperature of 65F, a relative humidity of 20%, and with single windows in wind, at what outside temperature will moisture be deposited?

Solution: Referring to Table 1, find the figure 20 in the second column in the second division of figures opposite 65F in the first column. Referring to the fifth column we find the answer to be 4F. Since this figure appears in bold face type it indicates that the temperature of the inside surface of the glass is below 32F, and that consequently the moisture will be deposited in the form of frost.

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WINDOW CONDENSATION

TABLE 2.—RELATIVE HUMIDITY IN BUILDINGS AT WHICH MOISTURE WILL DEPOSIT ON VARIOUS TYPE WINDOWS FOR DIFFERENT INSIDE AND OUTSIDE TEMPERATURES

Inside Temperature, °F.	Outside Temperature, °F.	Inside Relative Humidity (%) At Which Moisture Will Deposit			
		Single Windows		Double Windows	
		Still Air	Wind	Still Air	Wind
60	—50	9	4	34	28
	—40	12	5	38	32
	—30	16	7	42	36
	—20	20	10	47	41
	—10	25	14	52	46
	0	32	20	57	52
	10	39	28	62	58
	20	47	36	69	65
	30	57	48	76	72
	40	70	62	84	80
65	—50	9	3	34	26
	—40	12	4	38	30
	—30	14	6	42	34
	—20	18	9	46	39
	—10	23	13	50	45
	0	29	18	55	49
	10	36	24	60	56
	20	43	32	66	63
	30	52	41	73	70
	40	63	54	80	78
70	—50	9	3	34	26
	—40	11	4	36	30
	—30	14	6	41	34
	—20	18	9	46	38
	—10	22	12	49	42
	0	27	16	55	47
	10	33	22	59	53
	20	40	30	63	59
	30	50	38	71	66
	40	60	49	79	73
75	—50	8	3	33	26
	—40	10	4	36	29
	—30	13	6	40	32
	—20	17	8	44	35
	—10	21	11	48	42
	0	25	15	52	46
	10	31	20	57	52
	20	37	26	62	58
	30	45	34	68	64
	40	53	43	74	70
80	—50	8	2	32	25
	—40	10	3	35	28
	—30	13	5	38	31
	—20	16	7	42	35
	—10	20	10	46	39
	0	24	13	50	44
	10	29	18	54	49
	20	35	24	59	54
	30	42	30	65	60
	40	50	40	71	67

NOTE: If the answer, appearing in any of the last four columns, is printed in bold-face type, the dewpoint temperature falls below 32F and the condensation on the window will be in the form of frost.

Example: Given a room temperature of 70F in a locality where the lowest outside temperature reached is — 10F. With a double window in still air, what relative humidity can be carried in the room during the coldest weather before moisture is deposited on the window?

Solution: Find the figure — 10 in the second column of Table 2 opposite the figure 70 in the first column. In the fifth column, opposite the — 10, we find that 49% relative humidity will give us moisture deposition, so that any humidity less than this will not give us moisture on the window.

Example: With a room temperature of 75F and with the expectation of zero weather outside, what relative humidity can be carried before moisture is deposited on a single window with wind?

Solution: Referring to Table 2, find the figure 0 in the second column opposite 75F in the first column. In the fourth column we find the answer to be 15%. Since the figure 15 appears in bold face type it indicates that for 15% relative humidity or more, under the given conditions, the moisture will be deposited in the form of frost.

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TEMPERATURES OF COOLING WATER FROM VARIOUS SOURCES

TABLE 1.—TEMPERATURE OF WELL AND SURFACE WATERS DURING SUMMER MONTHS

Location	Wells		Lakes or Rivers		Cooling Ponds	
	Min. Deg. F.	Max. Deg. F.	Min. Deg. F.	Max. Deg. F.	Min. Deg. F.	Max. Deg. F.
Alabama	67	73	80	85	81	87
Arizona	62	68	70	95	72	78
Arkansas	62	68	80	85	80	84
California (N)	62	68	65	80	61	67
California (S)	72	78	85	95	70	76
Colorado	52	58	60	80	68	74
Connecticut	52	58	70	75	73	79
District of Columbia	52	58	70	80	77	83
Florida	72	83	80	90	81	87
Georgia	62	73	75	85	80	86
Idaho	47	58	65	75	68	74
Illinois	52	63	70	80	74	80
Indiana	52	63	75	80	76	82
Iowa	52	58	72	80	74	80
Kansas	57	63	75	80	76	82
Kentucky	57	63	75	82	76	82
Louisiana	70	78	82	87	81	87
Maine	42	53	65	70	67	73
Maryland	54	63	75	80	76	72
Massachusetts	50	56	70	75	72	78
Michigan	44	53	65	75	70	76
Minnesota	40	53	65	75	70	76
Mississippi	67	73	80	87	81	87
Missouri	57	65	78	85	76	82
Montana	42	53	65	70	67	73
Nebraska	52	58	72	80	74	80
Nevada	52	63	70	75	65	71
New Hampshire	47	53	70	75	72	78
New Jersey	52	63	72	80	75	81
New Mexico	57	68	70	85	64	70
New York	47	60	68	75	72	78
North Carolina	62	68	75	85	79	85
North Dakota	40	48	68	75	70	76
Ohio	52	62	72	80	74	80
Oklahoma	62	68	80	85	77	83
Oregon	52	63	60	75	67	73
Pennsylvania	50	60	70	80	74	80
Rhode Island	50	58	70	75	72	78
South Carolina	67	73	80	85	80	86
South Dakota	47	53	70	75	70	76
Tennessee	62	68	75	85	79	85
Texas	62	78	80	90	77	83
Utah	52	58	70	80	65	71
Vermont	47	53	68	72	70	76
Virginia	57	63	75	80	78	84
Washington	48	58	70	80	64	70
West Virginia	52	58	70	80	75	81
Wisconsin	42	53	68	75	72	78
Wyoming	42	53	60	70	67	73

The two tables on this data sheet give information on the temperatures which can be expected of water from various sources such as wells, lakes, rivers, cooling ponds, spray ponds, and both natural and mechanical draft cooling towers. Both maximum and minimum temperatures are given since local conditions will have some effect on the temperature of water. Table 1 gives temperatures of water for wells, lakes, rivers, and cooling ponds. These figures are from or based on data compiled by the United States Geological Survey. They are said to be

(Concluded on other side)

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TEMPERATURES OF COOLING WATER FROM VARIOUS SOURCES

TABLE 2—TEMPERATURE OF WATER FROM ATMOSPHERIC COOLING EQUIPMENT DURING SUMMER MONTHS

State	Method of Cooling					
	Spray Ponds		Natural Draft Cooling Towers		Mechanical Draft Cooling Tower	
	Temperatures To Be Expected, °F					
	Min.	Max.	Min.	Max.	Min.	Max.
Alabama	81	85	80	84	79	87
Arizona	72	76	71	75	70	78
Arkansas	80	84	79	83	78	86
California (N)	61	65	60	64	59	67
California (S)	70	74	69	73	68	76
Colorado	68	72	67	71	66	74
Connecticut	73	77	72	76	71	79
District of Columbia	77	81	76	80	75	83
Florida	81	85	80	84	79	87
Georgia	80	84	79	83	78	86
Idaho	68	72	67	71	66	74
Illinois	74	78	73	77	72	80
Indiana	76	80	75	79	74	82
Iowa	74	78	73	77	72	80
Kansas	76	80	75	79	74	82
Kentucky	76	80	75	79	74	82
Louisiana	81	85	80	84	79	87
Maine	67	71	66	70	65	73
Maryland	76	70	75	69	74	82
Massachusetts	72	76	71	75	70	78
Michigan	70	72	69	71	68	76
Minnesota	70	72	69	71	68	76
Mississippi	81	85	80	84	79	87
Missouri	76	80	75	79	74	82
Montana	67	71	66	70	65	73
Nebraska	74	78	73	77	72	80
Nevada	65	69	64	68	63	71
New Hampshire	72	76	71	75	70	78
New Jersey	75	79	74	78	73	81
New Mexico	64	68	63	67	62	80
New York	72	76	71	75	70	78
North Carolina	79	83	78	82	77	85
North Dakota	70	74	69	73	68	76
Ohio	74	78	73	77	72	80
Oklahoma	77	81	76	80	75	83
Oregon	67	71	66	70	65	73
Pennsylvania	74	78	73	77	72	80
Rhode Island	72	76	71	75	70	78
South Carolina	80	84	79	83	78	86
South Dakota	70	74	69	73	68	76
Tennessee	79	83	78	82	77	85
Texas	77	81	76	80	75	83
Utah	65	69	64	68	63	68
Vermont	70	74	69	73	68	76
Virginia	78	82	77	81	76	84
Washington	64	68	63	67	62	70
West Virginia	75	79	74	78	73	81
Wisconsin	72	76	71	75	70	78
Wyoming	67	71	66	70	65	73

not more than 1F or 2F in error. Where water is supplied from the municipal water reservoir the data from Table 1 under Lakes will apply. If the system employs wells, the temperatures given for wells will apply providing the wells are non-thermal.

Table 2 gives the temperature of water from various atmospheric cooling equipment. Again both maximum and minimum temperatures are given since the local conditions such as exposure to wind, and the design of the equipment will have some effect on the temperatures of the delivered water.

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INFILTRATION THROUGH DOORS

TABLE 1.—INFILTRATION THROUGH ENTRANCES
(Doors in One Wall Only)

No. of Passages Per Hr. Up To	Single Swing Doors		Swing Doors—Vestibule		Revolving Doors	
	Infiltration Per Passage Cu. Ft.	Heat Gain Per Passage Per Degree Temp. Dif. B.t.u.	Infiltration Cu. Ft. Per Passage	Heat Gain B.t.u. Per °F Per Passage	Infiltration Cu. Ft. Per Passage	Heat Gain B.t.u. Per °F Per Passage
100	110	1.98	83	1.49	30	0.54
200	110	1.98	83	1.49	30	0.54
300	110	1.98	83	1.49	30	0.54
400	110	1.98	83	1.49	29	0.52
500	110	1.98	83	1.49	29	0.52
600	110	1.98	82	1.47	28	0.50
700	110	1.98	82	1.47	27	0.49
800	110	1.98	82	1.47	26	0.47
900	109	1.96	82	1.47	25	0.45
1000	109	1.96	82	1.47	24	0.43
1100	109	1.96	82	1.47	23	0.41
1200	108	1.95	82	1.47	21	0.38
1300	108	1.95	82	1.47	19	0.34
1400	108	1.95	81	1.46	18	0.32
1500	108	1.95	81	1.46	17	0.31
1600	108	1.95	81	1.46	16	0.29
1700	107	1.93	81	1.46	15	0.27
1800	105	1.89	80	1.44	14	0.25
1900	104	1.87	80	1.44	13	0.23
2000	100	1.80	79	1.42	12	0.22
2100	96	1.73	79	1.42	11	0.20

TABLE 2.—INFILTRATION THROUGH ENTRANCES
(Doors in More Than One Wall)

No. of Passages Per Hr. Up To	Single Swing Doors		Swing Doors—Vestibule		Revolving Doors 6 Ft. x 7 Ft.		Revolving Doors 7 Ft. x 7 Ft.	
	Infiltration Cu. Ft. Per Passage	Heat Gain B.t.u. Per °F Per Passage	Infiltration Cu. Ft. Per Passage	Heat Gain B.t.u. Per °F Per Passage	Infiltration Cu. Ft. Per Passage	Heat Gain B.t.u. Per °F Per Passage	Infiltration Cu. Ft. Per Passage	Heat Gain B.t.u. Per °F Per Passage
100	168	3.02	125	2.25	36	0.65	48	0.86
200	168	3.02	125	2.25	36	0.65	48	0.86
300	168	3.02	125	2.25	36	0.64	48	0.86
400	168	3.02	125	2.25	35	0.63	47	0.85
500	168	3.02	125	2.25	35	0.62	46	0.83
600	168	3.02	125	2.25	34	0.61	45	0.81
700	168	3.02	125	2.25	32	0.58	43	0.78
800	168	3.02	125	2.25	30	0.54	41	0.74
900	168	3.02	125	2.25	28	0.50	39	0.70
1000	168	3.02	125	2.25	26	0.47	36	0.65
1100	168	3.02	125	2.25	23	0.42	33	0.59
1200	168	3.02	125	2.25	21	0.38	30	0.54
1300	168	3.02	125	2.25	20	0.36	28	0.50
1400	168	3.02	125	2.25	19	0.34	25	0.45
1500	168	3.02	125	2.25	17	0.31	23	0.41
1600	167	3.01	125	2.25	15	0.27	21	0.38
1700	163	2.93	124	2.23	14	0.25	19	0.34
1800	159	2.86	122	2.20	13	0.23	18	0.32
1900	156	2.81	120	2.16	12	0.21	17	0.30
2000	152	2.74	118	2.12	11	0.20	16	0.29
2100	147	2.64	115	2.07	10	0.18	15	0.27

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INFILTRATION THROUGH DOORS

TABLE 3.—ENTRANCE PASSAGES PER OCCUPANT PER HOUR FOR VARIOUS TYPES OF BUILDINGS

Banks	8	Department stores	8
Barber shops	4	Furriers	3
Brokers' offices	8	Lunchrooms	6
Candy & soda	6	Men's shops	4
Cigars & tobacco	25	Office buildings	2
5 & 10c stores	12	Public buildings	3
Dress shops	3	Restaurants	3
Drug stores	8	Shoe stores	4

The two tables on the other side of this sheet and the one on this side are useful for estimating the load placed on air cooling systems due to the infiltration of air through doors. Practically every time a door leading to an air conditioned space is opened, some outside air will be admitted, the amount depending upon the number of factors, such as wind velocity, size, location and type of doors, and the length of time the doors remain open.

In calculating the heat load due to infiltration through doors it is first necessary to select the type of application, that is the type of store the installation is to be made in, as a bank, drug store or restaurant. Table 3 shows the number of entrance passages to be expected each hour for each occupant for various applications.

The amount of air entering each time the doors are opened depends on the type of door and whether there are doors in one wall or more than one wall. Tables 1 and 2 have been set up to give the amount of air per passage for single swing doors, swing doors with vestibules and revolving doors. Table 1 is for applications where the doors are in one wall only while Table 2 covers applications with doors in more than one wall.

The use of these tables may be explained by the following example: Suppose that we have a drug store which has an average occupancy of ten persons. Table 3 shows that there will be eight entrance passages per hour for each occupant in the drug store. Since there are ten occupants, the total number of passages per hour would be eighty. If this door is a single swinging door and there are entrances in one wall only, we would use Table 1 and in the line of 100 passages per hour and in the column of infiltration per passage for single swing doors, we would find 110 cu. ft. per passage. In other words each person entering or leaving would allow 110 cu. ft. of air into the store. Since there are eighty passages per hour, the total infiltration will be 8,800 cu. ft. per hour, and the total heat gain per hour per degree temperature difference would be $1.98 \times 80 = 158.4$ B.t.u. per hr.

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CITY WATER TEMPERATURES

Monthly Mean Temperatures of Water in Various Large Cities, 1936

City and State	Temperature of Water at Main Outlet, Deg. F					
	April	May	June	July	August	Sept.
Akron, Ohio	43.7	61.0	69.3	74.3	74.7	69.4
Albany, N. Y.	40.0	52.0	60.0	56.0	66.0	65.0
Atlanta, Ga.	59.0	71.5	78.1	83.5	79.5	77.8
Baltimore, Md.	47.0	53.0	61.0	66.0	70.0	64.0
Birmingham, Ala.	63.0	73.0	78.0	82.0	81.0	79.0
Bridgeport, Conn.	43.0	45.0	53.0	62.0	65.0	66.0
Buffalo, N. Y.	32.0	37.0	62.0	71.0	73.0	66.0
Cambridge, Mass.	43.0	55.0	64.0	72.0	74.0	68.8
Canton, Ohio	Average of 55 degrees the year round.					
Chattanooga, Tenn.	64.0	67.0	73.0	79.0	79.5	76.5
Chicago, Ill.	39.2	47.1	55.4	68.0	69.4	62.5
Cincinnati, Ohio	49.0	66.0	76.0	82.0	81.0	77.0
Cleveland, Ohio	39.0	50.0	58.0	68.0	73.5	71.0
Columbus, Ohio	46.0	64.0	72.0	76.0	76.0	74.0
Dallas, Texas	65.0	66.0	77.0	82.0	82.5	74.0
Des Moines, Iowa	44.1	49.1	58.2	65.7	72.9	71.1
Detroit, Mich.	41.0	56.0	64.0	75.0	74.0	68.0
Denver, Col.	54.3	61.7	63.1	70.9	70.7	68.0
Duluth, Minn.	33.4	52.7	57.6	70.6	66.6	58.7
Elizabeth, N. J.	43.3	48.8	51.7	54.7	61.3	66.7
El Paso, Texas	80.0	82.0	84.0	85.0	85.0	84.0
Erie, Penn.	36.9	53.7	63.8	72.3	72.9	69.8
Evansville, Ind.	56.0	66.0	85.0	84.0	83.0	74.0
Fort Wayne, Ind.	49.0	67.0	73.0	79.0	78.0	73.0
Fort Worth, Texas	62.0	72.0	81.0	83.0	83.0	81.0
Gary, Ind.	41.0	50.0	60.0	70.0	70.0	65.0
Grand Rapids, Mich.	54.0	66.0	71.0	73.0	74.0	69.0
Hartford, Conn.	44.0	54.0	59.0	66.0	70.0	69.0
Houston, Texas	84.0	84.0	84.0	84.0	84.0	84.0
Indianapolis, Ind.	53.0	68.0	73.0	80.0	82.0	77.0
Jacksonville, Fla.	79.2	80.6	84.8	86.3	86.7	82.4
Kansas City, Kan.	63.0	78.0	84.0	93.0	91.0	85.0
Knoxville, Tenn.	59.2	75.6	81.5	84.0	84.3	79.9
Los Angeles, Cal.	63.0	68.0	73.0	74.0	76.0	75.0
Louisville, Ky.	49.0	69.0	77.0	82.0	82.0	77.0
Lowell, Mass.	50.0	50.0	50.0	50.0	50.0	50.0
Miami, Fla.	Varies from 70-75 degrees the year round.					
Milwaukee, Wis.	38.4	42.8	49.7	57.0	60.6	56.6
Minneapolis, Minn.	40.5	61.2	69.3	80.2	73.0	67.6
Nashville, Tenn.	61.0	76.0	84.0	88.0	88.0	84.0
Newark, N. J.	45.0	56.0	64.0	68.5	71.5	70.5
New Bedford, Mass.	42.0	48.0	60.0	68.0	71.0	69.0
New Haven, Conn.	50.0		No Data		70.0	60.0
New Orleans, La.	66.0	77.0	86.0	89.0	90.0	90.0
New York, N. Y.	45.0	55.0	63.0	70.0	70.0	69.0
Norfolk, Va.	62.0	70.0	77.5	83.0	83.0	79.5
Oakland, Cal.	55.0	57.0	59.0	62.0	64.0	64.0
Oklahoma City, Okla.	55.4	68.0	73.4	77.2	77.0	72.4
Omaha, Neb.	50.8	55.8	68.0	80.9	79.4	69.1
Paterson, N. J.	46.0	49.2	54.6	55.9	59.0	64.0
Peoria, Ill.	54.0	54.0	56.0	56.0	56.0	54.0
Philadelphia, Penn.	40.0	68.0	71.0	79.0	77.0	72.0
Pittsburgh, Penn.	46.4	66.2	75.2	80.6	80.6	75.2
Portland, Ore.	43.7	50.0	56.0	62.0	55.0	51.6
Providence, R. I.	48.0	56.0	62.0	64.0	65.0	63.0
Reading, Penn.	46.4	59.9	70.7	78.8	76.1	71.6
Richmond, Va.	56.8	69.6	74.7	80.4	79.5	73.4
Rochester, N. Y.	41.9	52.8	62.3	68.0	68.9	64.6
St. Louis, Mo.	53.0	69.0	77.0	85.0	83.0	75.0
Salt Lake City, Utah	50.0	50.0	58.0	58.0	57.0	50.0
San Francisco, Cal.	60.0	60.0	60.0	60.0	60.0	60.0
San Antonio, Texas	76.0	76.0	76.0	76.0	76.0	76.0
Scranton, Penn.	No Data	58.2	64.1	70.3	70.9	67.9
South Bend, Ind.	Average of 60 degrees the year round.					
Spokane, Wash.	Average of 47 degrees the year round.					
Springfield, Mass.	41.0	49.0	52.0	54.0	55.0	54.0
Syracuse, N. Y.	44.2	50.5	59.8	66.4	70.4	67.7
Tacoma, Wash.	49.0	51.0	53.0	59.0	61.0	60.0
Tampa, Fla.	80.0	85.0	87.0	85.0	85.0	83.0
Toledo, Ohio	48.0	66.0	72.0	87.0	85.0	72.0
Tulsa, Okla.	62.2	70.0	77.2	81.8	81.8	79.1
Utica, N. Y.	43.2	53.6	63.0	70.0	70.2	67.6
Washington, D. C.	49.0	49.0	43.0	67.0	73.0	75.0
Waterbury, Conn.	47.0	64.0	68.0	74.0	74.0	73.0
Wilmington, Del.	52.0	68.0	73.0	78.0	79.0	73.0
Worcester, Mass.	46.0	53.5	65.0	70.0	73.0	68.5
Yonkers, N. Y.	60.0	69.0	75.0	77.0	79.0	78.0
Youngstown, Ohio	43.0	50.5	58.5	62.5	66.0	68.5

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CITY WATER TEMPERATURES

The table on the other side of this sheet gives the monthly mean temperatures of water as taken from mains in seventy-eight cities having populations of 100,000 or over. The data were compiled by the Bureau of Foreign and Domestic Commerce of the Department of Commerce from information supplied by the various city water authorities.

While the temperatures given are for the year 1936, it is reasonable to expect that they will not vary greatly from year to year and they should therefore furnish a good indication of the temperatures to be expected.

It is important to note that in practically all cities the water temperatures during the late summer months are considerably higher than during the earlier months, thus indicating an increased consumption during the later months.

When the water temperatures are compared with the normal monthly air temperatures it is found that in general the water temperatures are below the air temperatures during the months of April, May, June and July and above the air temperatures during August and September. In a few cities the water temperatures will be as much as 12 to 16 degrees above the mean monthly temperatures during September. The average is, however, about 5°. During the month of August the mean water temperatures in a majority of the cities are fairly close to the mean monthly air temperatures.

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H. & V.'s REFERENCE DATA—110

AIR CONDITIONING APPLICATION CODE—PART 1

as adopted by the Air Conditioning Manufacturers' Association, May 16, 1936.

A. SCOPE AND PURPOSE—This code is limited to application engineering standards and practices for determining the conditions and the loads for which to design systems for conditioning air for the comfort of persons, for installation within the United States.

These are minimum standards and are to be construed as defining recommended practice, rather than as hindering progress, or as preventing the use of other standards where such are justified by the economies of a case and where departures below good practice minimums are made clear to the buyer.

B. NAME—The name "Air Conditioner" or "Air Conditioning" shall not be applied to any air treating combination which is not designed to embody the minimum complement of functions as defined below in paragraph C. If a system embodies less, it shall be called by a name which describes only the functions performed, and does not incorporate the words "Air Conditioning" or "Air Conditioner."

C. DEFINITIONS — *Application engineering standards* for air conditioning are those relating to conditions and factors which form the basis of design load estimating and specifications of performance. These are distinguished from standards of apparatus design, of installation practices, of trade practices and of safety.

The design load is the capacity required of the apparatus to maintain specified conditions inside when specified extreme conditions of temperature and humidity obtain outside and when all sources of load are taken at the maximum that will occur coincidentally, during periods of outside extremes.

Design inside conditions are the dry and wet bulb temperatures (or relative humidity) specified to be maintained inside at the time of occurrence of the design load.

Design outside conditions are the dry and wet bulb temperatures (or relative humidity) specified for design load computation.

Comfort air conditioning provides ventilation, air circulation, air cleaning and maintains temperature and humidity for the comfort of people.*

An air conditioning system provides ventilation, air circulation, air cleaning and equipment for maintaining temperature and humidity within prescribed limits.*

An air conditioner is a specific combination consisting of means for ventilation, air circulation, air cleaning and heat transfer with control means for maintaining temperature and humidity within prescribed limits.*

A cooling (summer) air conditioner is a specific air treating combination consisting of means for ventilation, air circulation, air cleaning, cooling and dehumidifying with control means for maintaining room temperature and humidity within prescribed limits.*

A heating (winter) air conditioner is a specific air treating combination consisting of means for ventilation, air circulation, air cleaning, heating and humidifying with control means for maintaining room temperature and humidity within prescribed limits.*

D. DESIGN LOAD FACTORS—The following shall be specified as a basis for the calculation of design loads: design inside conditions, design outside conditions, number of occupants and other sources of substantial load from within doors, c.f.m. per person assumed for ventilation, time of day at which maximum load is estimated to occur, and class of activity assumed for occupants.

Calculations of design loads shall include the following sources of heat loss and heat gain: *Heat loss* (winter load): Conduction through physical barriers, such as walls, doors, windows, floors, ceilings, etc., and heat and moisture required for incoming outdoor air. *Heat gain* (summer load): Conduction through physical barriers, such as walls, doors, windows, floors, ceilings, etc.; heat from sunshine, direct effect through glass areas exposed to the sun and additional conduction through opaque barriers, such as walls, roofs, etc., exposed to the sun; heat and moisture introduced by incoming outdoor air; heat and moisture liberated by occupants; and heat and moisture liberated by appliances, illumination, combustion, etc.

The basis of all these design load values shall conform with the data in the current issue of the ASHVE Guide except where these standards give other specific requirements.

E. DESIGN OUTSIDE CONDITIONS — *Heating:* The design outside dry bulb temperature for calculating heating load shall be that minimum temperature which has been recorded on more than 2% of the days when heating is required. The local weather bureau information for the past 10 years shall be used as the authority for this record. For the purpose of this code, it is assumed that heating is required on any or all days when the average daily temperature is 65F or less. For convenience, Table 1 gives approved temperatures to be used when local data are not available.

Cooling: The design outside conditions for cooling shall be the average for ten years of the highest dry and wet bulb temperatures remaining each year after excluding those higher temperatures which have occurred on only ten days of each year and for durations of less than three hours.

Figs. 1 and 2 show maps of the United States, giving approximate design dry bulb and wet bulb temperatures which are approved for use until additional data are available. If the application of the above formula to authoritative weather records for an individual locality determines outside design conditions which differ from those given by the map, they will be approved instead.

These design outside conditions are considered to occur at 3 p.m.

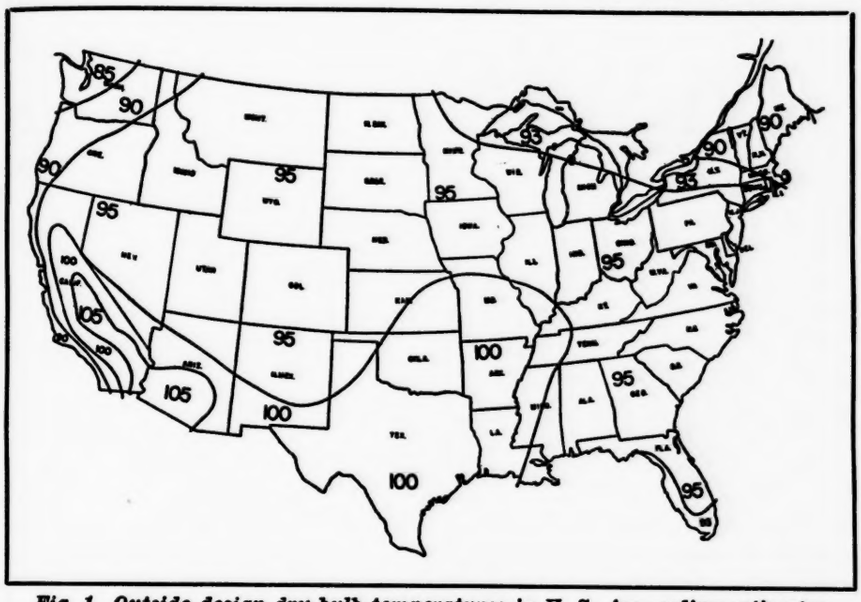

Fig. 1. Outside design dry bulb temperatures in U. S., for cooling estimates

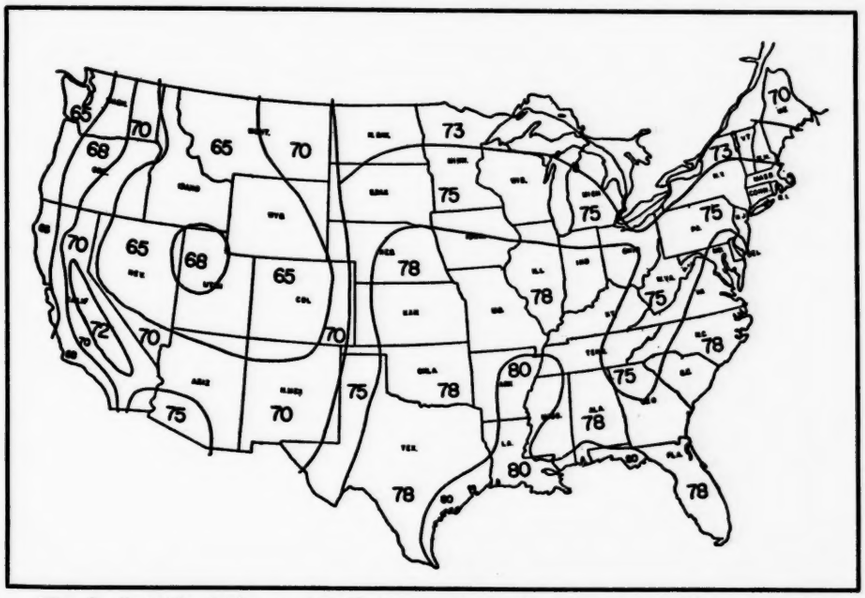

Fig. 2. Outside design wet bulb temperatures in U. S., for cooling estimates

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*Taken from ASRE code for rating and testing air conditioning equipment.

(Concluded on H. & V.'s REFERENCE DATA 113 and 114)

AIR CONDITIONING APPLICATION CODE—PART 1

as adopted by the Air Conditioning Manufacturers' Association, May 16, 1936.

TABLE 1.—OUTSIDE AIR CONDITIONS FOR HEATING ESTIMATES

The following table lists the recommended outdoor winter temperatures to use as the basis for preparing heating estimates. These figures should be used unless the customer specifies the temperature upon which the estimate shall be made

State and City	Design Temp. F
ALABAMA	
Anniston	5
Birmingham	5
Gadsden	0
Mobile	15
Montgomery	10
Tuscaloosa	5
ARIZONA	
Bisbee	15
Flagstaff	—15
Globe	20
Nogales	20
Phoenix	25
Tucson	20
Yuma	20
ARKANSAS	
Fort Smith	10
Hot Springs	5
Little Rock	5
Pine Bluff	10
Texarkana	10
CALIFORNIA	
Bakersfield	15
Fresno	25
Los Angeles	30
Montague	0
Pasadena	25
Sacramento	25
San Diego	35
San Francisco	35
San Jose	20
COLORADO	
Boulder	—15
Colorado Springs	—25
Denver	—20
Fort Collins	—30
Grand Junction	—15
Pueblo	—25
CONNECTICUT	
Bridgeport	—5
Hartford	—5
New Haven	—5
New London	—5
Norwalk	—5
Torrington	—10
Waterbury	—15
DELAWARE	
Dover	5
Milford	5
Wilmington	5
DIS. OF COLUMBIA	
Washington	0
FLORIDA	
Fort Myers	35
Gainesville	20
Jacksonville	25
Key West	45
Miami	35
Orlando	35
Pensacola	20
Tallahassee	25
Tampa	35
GEORGIA	
Athens	10
Atlanta	10
Augusta	15
Columbus	10
Macon	15
Rome	10
Savannah	15
Way Cross	20
IDAHO	
Boise	0
Lewiston	5
Pocatello	—5
Twin Falls	—10
ILLINOIS	
Aurora	—10
Bloomington	—10
Chicago	—10
Danville	—5
Decatur	—10
Elgin	—10
Joliet	—10
Peoria	—10
Rockford	—10
Springfield	—10
INDIANA	
Elkhart	—5
Evansville	0
Fort Wayne	—10
Indianapolis	—5
South Bend	—5
Terre Haute	—5
IOWA	
Burlington	—10
Cedar Rapids	—5
Clinton	—10
Council Bluffs	—10
Davenport	—10
Des Moines	—15
Dubuque	—10
Fort Dodge	—20
Keokuk	—10
Marshalltown	—15
Sioux City	—20
Waterloo	—15
KANSAS	
Atchison	—10
Concordia	—10
Dodge City	—10
Leavenworth	—10
Salina	—15
Topeka	—10
Wichita	—5
KENTUCKY	
Bowling Green	0
Frankfort	0
Hopkinsville	0
Lexington	0
Louisville	0
Owensboro	0
LOUISIANA	
Alexandra	20
Baton Rouge	20
New Orleans	25
Shreveport	15
MAINE	
Bar Harbor	—15
Belfast	—5
Eastport	—10
Lewiston	—15
Millinocket	—15
Orono	—20
Portland	—10
Rumford	—20
MASSACHUSETTS	
Amherst	—10
Boston	0
Clinton	—10
Concord	—15
Rall River	—10
Fitchburg	—10
Lawrence	—10
Lowell	—15
New Bedford	0
Pittsfield	—10
Plymouth	—5
Springfield	—10
Worcester	—10
Framingham	—10
MARYLAND	
Annapolis	5
Baltimore	5
Cambridge	5
Frederick	—5
Frostburg	—5
Salisbury	10
MICHIGAN	
Alpena	—10
Ann Arbor	—5
Big Rapids	—15
Calumet	—15
Detroit	0
Flint	—10
Escanaba	—15
Grand Rapids	—10
Kalamazoo	—5
Lansing	—10
Ludington	—10
Marquette	—10
Muskegon	0
Port Huron	—5
Saginaw	—10
Sault Ste. Marie	—20
MINNESOTA	
Alexandria	—25
Duluth	—25
Minneapolis	—20
St. Cloud	—25
St. Paul	—20
MISSISSIPPI	
Biloxi	15
Columbus	15
Hattiesburg	15
Jackson	15
Meridian	10
Natchez	15
Vicksburg	15
MISSOURI	
Columbia	—10
Hannibal	—10
Kansas City	—5
St. Louis	—5
St. Joseph	—10
Springfield	—10
MONTANA	
Anaconda	—15
Billings	—25
Butte	—20
Great Falls	—20
Havre	—30
Helena	—25
Miles City	—35
Missoula	—20
NEBRASKA	
Grand Island	—20
Hastings	—25
Lincoln	—10
Norfolk	—15
North Platte	—20
Omaha	—10
York	—15
NEVADA	
Las Vegas	20
Reno	—5
Tonopah	5
Winnemucca	—15
NEW HAMPSHIRE	
Berlin	—25
Claremont	5
Concord	—20
Franklin	—15
Hanover	—20
Keene	—20
Nashua	—15
NEW JERSEY	
Asbury Park	5
Atlantic City	10
Bayonne	5
Belvidere	—10
Bridgeton	5
Dover	0
Elizabeth	0
Englewood	—5
Jersey City	5
Lambertville	—5
Long Branch	5
Newark	5
New Brunswick	0
Paterson	—5
Phillipsburg	—5
Plainfield	—5
Somerville	—5
South Orange	—5
Trenton	5
NEW MEXICO	
Albuquerque	5
Raton	—5
Roswell	—10
Santa Fe	0
NEW YORK	
Albany	—5
Auburn	—5
Binghamton	—10
Buffalo	—5
Cortland	—10
Elmira	0
Glens Falls	—15
Ithaca	—15
Jamestown	—10
Lake Placid	—20
Little Falls	—20
Lockport	—5
New York City	0
Norwich	—15
Ogdensburg	—20
Oneonta	—15
Oswego	—10
Port Jervis	—5
Rochester	—5
Syracuse	—15
Watertown	—15
NORTH CAROLINA	
Asheville	5
Charlotte	10
Greensboro	15
Newbern	20
Raleigh	15
Salisbury	10
Wilmington	20
Winston-Salem	10
NORTH DAKOTA	
Bismarck	—30
Devils Lake	—30
Grand Forks	—25
Jamestown	—25
Minot	—30
Williston	—35
OHIO	
Akron	—5
Cincinnati	—5
Cleveland	—5
Columbus	—10
Dayton	—10
Ironton	0
Lancaster	—5
Lima	—5
Marion	—10
Sandusky	0
Toledo	—5
Warren	—10
OKLAHOMA	
Ardmore	10
Bartlesville	—10
Guthrie	—5
Muskogee	0
Oklahoma City	—5
Tulsa	—5
OREGON	
Baker	0
Eugene	15
Pendleton	—15
Portland	15
Salem	15
Wamic	0
PENNSYLVANIA	
Altoona	—5
Bethlehem	—5
Clearfield	—10
Coatesville	—5
Erie	0
Franklin	—15
Harrisburg	5
Lancaster	—5
Lebanon	—5
New Castle	0
Philadelphia	5
Pittsburgh	—5
Reading	—5
Scranton	—10
Warren	—15
Williamsport	—5
York	—5
RHODE ISLAND	
Bristol	0
Providence	0
SOUTH CAROLINA	
Charleston	20
Columbia	15
Florence	20
Greenville	15
Spartanburg	15
SOUTH DAKOTA	
Aberdeen	—30
Huron	—20
Rapid City	—20
Sioux Falls	—20
Watertown	—20
TENNESSEE	
Chattanooga	15
Jackson	10
Johnson City	0
Knoxville	10
Memphis	5
Nashville	5
TEXAS	
Abilene	15
Amarillo	—5
Austin	10
Brownsville	30
Corpus Christi	20
Dallas	10
Del Rio	15
El Paso	10
Fort Worth	10
Galveston	25
Houston	25
Palestine	15
Port Arthur	10
San Antonio	20
Waco	20
UTAH	
Logan	—15
Ogden	—10
Salt Lake City	—5
VERMONT	
Bennington	—10
Burlington	—10
Newport	—15
Rutland	—20
VIRGINIA	
Charlottesville	10
Danville	10
Lynchburg	10
Norfolk	15
Petersburg	10
Richmond	10
Roanoke	5
WASHINGTON	
Aberdeen	10
Bellingham	10
Everett	10
Olympia	10
Seattle	10
Spokane	—10
Tacoma	10
Walla Walla	—10
WEST VIRGINIA	
Bluefield	—10
Charleston	0
Elkins	—10
Fairmont	—10
Huntington	—5
Martinsburg	—5
Parkersburg	—10
Wheeling	—5
WISCONSIN	
Ashland	—20
Beloit	—10
Eau Claire	—20
Green Bay	—20
La Crosse	—25
Madison	—10
Milwaukee	—10
Oshkosh	—15
Sheboygan	—10
WYOMING	
Casper	—20
Cheyenne	—20
Sheridan	—30

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AIR CONDITIONING APPLICATION CODE—PART 2

as adopted by the Air Conditioning Manufacturers' Association, May 16, 1936.

(Concluded from H. & V.'s REFERENCE DATA 111 and 112)

F. DESIGN INSIDE CONDITIONS—*Heating:* The design inside dry bulb temperature shall be 70F. The design inside relative humidity shall be 35% with an outside temperature of 30F.

Cooling: The design inside temperature and humidity shall be not more than that shown in Table 3.

G. HEAT FROM SUNSHINE—(Basis of determination to be added later.)

H. DESIGN OUTSIDE AIR QUANTITY—The total quantity of outside air used as a basis for design load calculations shall be the infiltration, or the air required for ventilation, whichever is greater. These shall be determined as outlined in paragraphs I and J below.

I. INFILTRATION—*Heating:* Infiltration rates for calculating heating loads shall be determined in accordance with the latest edition of the ASHVE Guide.

Cooling: Infiltration rates for calculating summer cooling loads shall not be less than those indicated in Tables 4 and 7.

J. VENTILATION REQUIREMENTS—In no case shall ventilation be less than that required by any local ordinance. For summer cooling, the ventilation per stated occupant shall be not less than that shown in Table 5.

K. DESIGN OCCUPANCY—The design load calculations shall be based on the stated occupancy of the building during the time of maximum design conditions. The heat given off by each occupant shall be calculated as not less than that in Table 6.

L. HEAT FROM APPLIANCES—(A table is to be included later.)

M. TRANSMISSION COEFFICIENTS—Heat conduction shall be based on transmission coefficient for physical barriers such as walls, doors, windows, ceilings, floors, etc., as given by the 1932 edition of ASHVE Guide.

N. TOTAL AIR CIRCULATION—The total air circulation is not specified. It shall be determined by the heating and cooling load and the type and arrangement of supply openings. It shall be adequate to meet the requirements under O.

O. AIR DISTRIBUTION—The quantity and temperature of the treated air and the method of introducing it to the conditioned space shall be designed to limit, to 3F or less, the variation in dry bulb temperature at the same level throughout that portion of a single room that is normally frequented by persons.

It is desirable to avoid air velocities exceeding 50 lin. ft. per min. in the zone between the floor and the 5-ft. level, in spaces normally frequented by persons who are not normally moving about.

Exception must be made of the vicinity of a supply or return grille when construction necessity requires it to be located below the 5-ft. level and in a space normally frequented by occupants.

For cooling, it is desirable that the difference between the temperature of air currents in the space frequented by occupants and the average temperature in such space be not greater than is shown in Table 2 for the various air current velocities.

TABLE 2.—AVERAGE TEMPERATURE DIFFERENCE, AIR CURRENTS IN OCCUPIED SPACES

AIR CURRENT VELOCITY F.P.M.	TEMP. DIF.—AVER. F MINUS CURRENT F
40 and over	2
Less than 40	3

P. DUCT CAPACITY—It is desirable that return ducts be sized large enough to handle 100% of the circulated air to permit economical heating and cooling prior to occupancy. It is desirable that the outside air duct be large enough to handle 100% of the total circulated air to permit economical operation during mild weather, but in every case it shall be large enough to admit 50% more air than that determined from the preferred values in Table 5.

Q. CAPACITY SPECIFICATIONS—The air conditioning equipment shall have a ca-

TABLE 3.—INSIDE DESIGN CONDITIONS FOR COMFORT COOLING

OUTSIDE DESIGN DRY BULB	CLASS AA SPECIAL APPLICATION OCCUPANCY OVER 40 MIN.			CLASS A AVERAGE APPLICATION OCCUPANCY OVER 40 MIN.			CLASS B OCCUPANCY UNDER 40 MIN.		
	DRY BULB	WET BULB	R.H. %	DRY BULB	WET BULB	R.H. %	DRY BULB	WET BULB	R.H. %
85	73	64	64	74	64	60	75	64	57
	74	62	53	75	62	50	76	63	48
	75	61	45	76	61	43	77	61	41
	76	59	38	77	59	35	78	59	32
90	75	66	65	77	67	62	78	68	60
	76	65	57	78	66	53	79	66	53
	77	63	48	79	65	48	80	65	45
	78	62	41	80	63	40	81	64	40
95	77	67	60	79	68	58	81	69	55
	78	66	54	80	67	51	82	68	49
	79	65	47	81	66	45	83	67	44
	80	64	42	82	65	40	84	66	38
100	78	69	65	80	69	58	82	70	57
	79	68	57	81	68	52	83	69	51
	80	66	50	82	66	44	84	68	45
	81	65	43	83	65	38	85	67	38
105	79	69	63	81	70	58	83	71	57
	80	68	57	82	68	51	84	70	50
	81	67	49	83	67	45	85	69	45
	82	66	43	84	66	39	86	68	40

NOTE: It is recognized that in certain unusual localities, the outside design dewpoint is substantially less than the dewpoint of the tabulated inside design conditions. In such cases, the code committee will entertain the recommendations by local authorities of the inside design conditions for use in those localities.

TABLE 4.—DOOR INFILTRATION IN SUMMER COMMERCIAL ESTABLISHMENTS—REVOLVING AND SWINGING DOORS OPENING TO OUTSIDE

APPLICATION	INFILTRATION C.F.M. PER PERSON IN ROOM	
	72-IN. REVOLVING DOOR	36-IN. SWINGING DOOR
Bank	6.5	8.0
Barber shop	4.0	5.0
Broker's office	5.5	7.0
Candy and soda	5.5	7.0
Cigar store	20.0	30.0
Department store (small)	6.5	8.0
Dress shop	2.0	2.5
Drug store	5.5	7.0
Furrier	2.0	2.5
Hospital room	—	3.5
Lunch room	4.0	5.0
Men's shop	2.7	3.7
Office (private)	—	2.5
Office (professional)	—	3.5
Restaurant	2.0	2.5
Shoe store	2.7	3.5

WHEN DOORS ARE LEFT OPEN CONTINUOUSLY

72-in. revolving door (panels open)	1200 c.f.m.
36-in. swinging door (standing open)	800 c.f.m.

NOTE: These values for swinging doors and for doors left open hold only where such doors are in one wall only, or where the doors in other walls are of the revolving type. If swinging doors are used for access, or doors are left open, in more than one wall, the infiltration cannot be estimated. The values for revolving doors hold regardless of number or location.

To determine the total c.f.m. infiltration due to opening of doors, multiply the design number of occupants by the factor from the above table for the kind of establishment in question. When there is more than one door, treat them as though there were only one, except in case of open doors.

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AIR CONDITIONING APPLICATION CODE—PART 2

as adopted by the Air Conditioning Manufacturers' Association, May 16, 1936.

TABLE 5.—VENTILATION STANDARDS

Application	C.F.M. per Person	
	Preferred*	Minimum*
Apartment†	15	10
Banking space	10	7½
Barber shop	10	7½
Beauty parlor	10	7½
Broker's board room	30	20
Cocktail bar	20	15
Department store	7½	5
Directors' room	30	30
Funeral parlor	10	5
Hospital room†	15	10
Hotel room	15	10
Office, general	15	10
Office, private†	30	15
Restaurant	15	12
Shop, retail	10	7½
Theater	7½	5
Note: For General Application		
Each person, not smoking	7½	5
Each person, smoking	30	25

†Figure at least one person for each 50 ft. of floor area, but do not pyramid such loads for multiple rooms beyond the maximum simultaneous peak.
*Whether the preferred or minimum values are used, the outside air ducts shall be sized to admit at least 50% more than the preferred values.

TABLE 6.—HEAT OF PERSONS—B.T.U. PER HR.

Design Room Temp.	Activity Class A per Person Sitting or Moving Slowly			Activity Class B per Person Working or Dancing		
	Sensible Heat B.T.U. per Hr.	Latent Heat B.T.U. per Hr.	Total Heat B.T.U. per Hr.	Sensible Heat B.T.U. per Hr.	Latent Heat B.T.U. per Hr.	Total Heat B.T.U. per Hr.
84	180	220	400	150	510	660
82	200	200	400	180	480	660
80	220	180	400	210	450	660
78	240	160	400	240	420	660
76	256	144	400	270	390	660

pacity equal to the design load defined in paragraph D under the following conditions:

Cooling: Design outside conditions defined in Sec. E (Cooling); design inside conditions defined in Sec. F (Cooling); design air quantity defined in Sec. G; and design occupancy defined in Sec. J.

Condensing medium for refrigeration equipment:

(1) Water cooled refrigeration equipment —(a) City water temperature not less than the average maximum value for the months of July and August. (ASHVE Guide); (b) Well water temperature not less than the average maximum value for the months of July and August; (c) Cooling Tower—The tower shall deliver water not more than 10F above the design wet bulb temperature.

(2) Air cooled refrigeration equipment. The condenser air temperature shall be not less than the design dry bulb. Allowance should be made for temperature rise above ambient for an air cooled condensing unit installed in a room, its amount depending on the unit size, room volume and rate of ventilation.

(3) Refrigeration equipment with Evaporative Condenser cooling. The condenser shall be selected for a wet bulb temperature not less than the design wet bulb. Allowance should be made for temperature rise above ambient for an Evaporative Condenser installed in a room, its amount depending on the unit size, room volume and rate of ventilation.

Heating: Design outside conditions as defined in Sec. E (Heating); design inside conditions as defined in Sec. F (Heating); design outside air quantity as defined in Sec. H (Heating); and heating medium at a temperature that can be maintained by the heat generating device when delivering heat to the heating device at a rate not less than the design heating load.

R. NOISE—The sound level meter specified by the American Standards Association's Committee on Sound, shall be used for noise readings. Noise values to be given in terms of db. based on the 40 db. weighted network. Where noise specifications are made they shall specify the room noise level due to the operation of the apparatus corrected to the noise level of the room when the apparatus is not in operation.

Noise readings in the conditioned space shall be taken—(a) In the case of apparatus located within the room, at a height of 5 ft. and at a distance of 5 ft. from the apparatus; (b) In the case of air inlet or outlet openings, at a height of 5 ft. and in front of the opening at a horizontal distance of 5 ft. from wall in which opening is located.

TABLE 7.—INFILTRATION THROUGH CRACKS AROUND WINDOWS

Type of Window	Remarks	C.F.M. per Ft. of Crack —Wind Vel. 10 M.P.H.		C.F.M. per Sq. Ft. of Entire Sash Area— Wind Vel. 10 M.P.H.	
		Single Window	Double Window or Storm Sash	Single Windows	
				Small	Large
Double hung wood sash windows (unlocked)	Average window not weatherstripped	0.36	0.28	0.46	0.29
	Average window weatherstripped	0.27	0.20	0.34	0.22
	Poorly fitted window not weatherstripped.	1.16	0.85	1.50	0.93
	Poorly fitted window weatherstripped	0.33	0.27	0.42	0.27
Double hung metal windows	Non-weatherstripped (unlocked)	0.78	0.60	1.00	0.62
	Weatherstripped (unlocked)	0.33	0.27	0.42	0.27
Single sash metal windows	Hollow metal (vertically pivoted)	1.75	1.48	—	—
	Residential casement	0.55	0.40	—	—

Infiltration through door cracks may be assumed to be twice that of window cracks. Small windows are approximately 30 in. x 72 in.; large windows are approximately 54 in. x 96 in.

Published by Heating & Ventilating, *148 Lafayette St., New York.*

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LAUNDRY FUEL BILLS $472.27 LESS . . . . . AFTER Detroit LoStoker IS INSTALLED

Manhattan Laundry

Zoric Dry Cleaning

229—231 WEST KING STREET

LANCASTER, PA.

May 3, 1937

Detroit Stoker Company,
1211 Morris Building,
Philadelphia, Pa.

Attention:- Mr. F. C. Duemler.

Gentlemen:-

In reply to your recent inquiry as to the performance and savings effected by one Detroit LoStoker installed by us in 1936, we have just completed a tabulation of our fuel bills and are pleased to give you the following summary:-

March 1935 to March 1936 -	Hand fired operation with run-of-mine coal	$1,925.61
March 1936 to March 1937 -	Stoker fired operation with nut, pea and slack coal	$1,453.34
	Saving	$ 472.27

The above saving was effected in spite of an increase in our business of approximately 15% during 1936 over 1935, and is more than pleasing to us. Also, we have had no difficulty in maintaining uniform steam pressure regardless of changes in load and we have had no difficulty with smoke from our chimney.

Our fireman is now able to take care of maintenance work throughout the laundry as the Stoker requires very little attention.

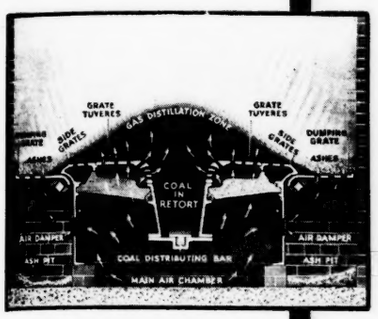
Needless to say, we are glad we selected the Detroit LoStoker.

Yours truly,

MANHATTAN LAUNDRY

Albert E. Cleaver

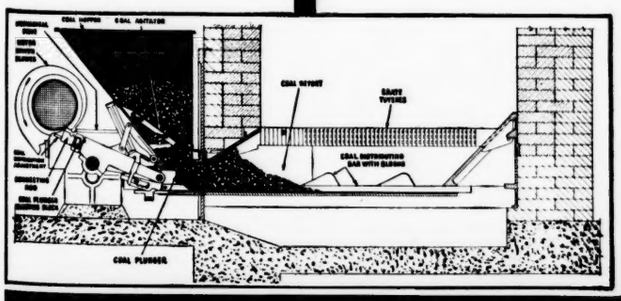
Albert E. Cleaver,
President.



Savings recorded in this letter are typical of results obtained by installation of Detroit LoStokers.

Not only laundries, but power and heating plants of all kinds obtain results like these.

Write for Bulletin 373



DETROIT STOKER COMPANY

Fifth Floor, General Motors Building, Detroit, Michigan • Works at Monroe, Michigan

District Offices in Principal Cities • Built in Canada at London, Ontario

HEATING & VENTILATING, *formerly* HEATING & VENTILATING MAGAZINE, published monthly by THE INDUSTRIAL PRESS, 148 Lafayette Street, New York, N. Y. Subscription rates: United States, $2.00; Canada, $2.50; Foreign, $3.00. Single copies, 30 cents. Vol. 34, No. 12, December, 1937. Entered as second-class matter, April 18, 1925, at the Post Office at New York, N. Y., under the Act of March 3, 1879.

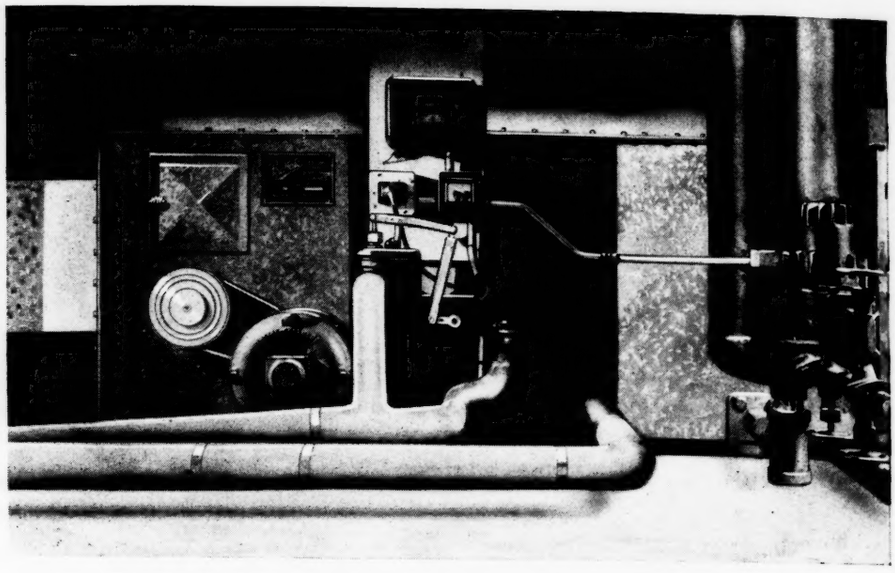
When You *Plan* Be Sure You *Get* AIR CONDITIONING

AIR CONDITIONING

Ask Your Consulting Engineer about

"Buffalo"

P. C. UNITS



This "Buffalo" P. C. Cabinet does a complete air conditioning job.

"Buffalo" P. C. Cabinet built for 30 ton capacity. Note the few coil connections necessary.

These complete, compact units are built to do the *whole* job of air conditioning. Therefore, you can keep them busy the year 'round—cooling and dehumidifying in summer; heating and humidifying in winter; cleaning the air at all times.

Furthermore, when you specify "Buffalo" equipment you automatically get the benefit of a long and wide experience in building equipment to solve air conditioning problems throughout the world.

So we repeat—"When you plan air conditioning be sure you get air conditioning." The safe way is to have "Buffalo" build your units to fit your exact needs.

Bulletin 501-B gladly mailed on request.

See our exhibit at the Fifth International Heating and Ventilating Exposition, Grand Central Palace, New York, January 24 to 28, 1938

BUFFALO FORGE COMPANY

480 Broadway BUFFALO, N. Y.

Branch Engineering Offices in Principal Cities

In Canada: Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

COMPLETE!

EVERY CONTROL IS A THRUSH CONTROL

1 Thrush Flow Control Valve.

2 Thrush Water Circulator.

6 No. 201 Thrush Radiant Heat Control.

8 No. 203 Thrush Modulating Boiler Control.

7 No. 198 Thrush Relay Transformer.

3 No. 4 Thrush Differential Pressure Relief Valve.

4 No. 12 Thrush Pressure Reducing Valve.

9 Thrush Gauge and Thermometer.

10 No. 75 High Pressure Thrush Relief Valve.

5 Air-tight Thrush Pressure Tank.

THRUSH

FLOW CONTROL

SYSTEM OF WARM WATER HEATING

★ FORCED CIRCULATION
★ FLOW CONTROL • AUTOMATIC
★ RADIANT HEAT CONTROL . . AND NOW

THRUSH MODULATING BOILER CONTROL

Which automatically adjusts boiler water temperature for outside weather and avoids overheating domestic water. Since it eliminates the necessity for double acting controls and permits lower mean temperature setting, it is more economical than ever in first cost as well as operating cost. Truly the most completely coordinated automatic warm water heating system yet developed. It has everything!

Announcing

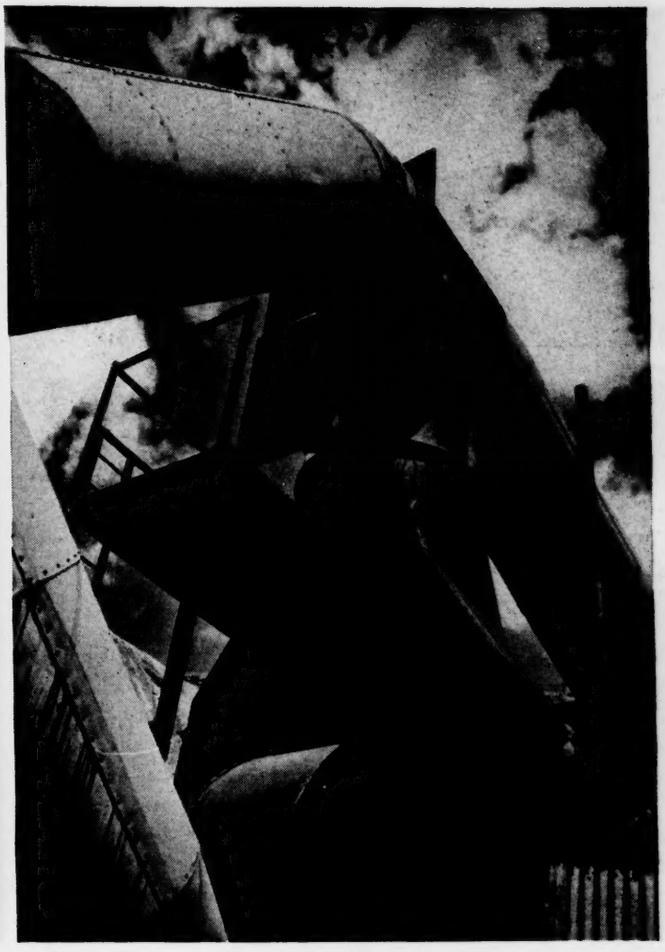
THE NEW ARMORED *Multi-Panel* AIR FILTER

The new *"armored"* panel with its 3 stages of air cleaning maintains the present high efficiency and normal operating resistance of the *Multi-Panel* filter and offers the added advantage of handling excessive lint concentrations or heavy dust loads without clogging.

See the *New ARMORED Multi-Panel* on display at the *Heating & Ventilating Exposition* — Booths 451-452-453. Also a complete exhibit of other American Air Filter products.

AMERICAN AIR FILTER CO., INC.
INCORPORATED
269 Central Ave., Louisville, Ky. In Canada: Darling Bros., Ltd., Montreal, P.Q.

FOR *double defense* AGAINST RUST



Beth-Cu-Loy galvanized sheets

WHEN customers want the best, recommend rust-resisting Beth-Cu-Loy. Here is sheet steel with two lines of defense against rust—a coating of durable galvanizing and, under this, rust-resisting copper-bearing steel.

Beth-Cu-Loy costs little more than ordinary steel—4½ to 5 per cent more for the sheets, an amount that almost disappears when the price of the whole job is figured. Yet, because of the copper in the steel, it has 2 to 3 times the resistance to rust.

Beth-Cu-Loy gives you a powerful argument when you talk to customers. The extra life, for so little extra money, has often been the deciding factor in clinching a contract.

BETHLEHEM STEEL COMPANY, *General Offices:* Bethlehem, Pa. *District Offices:* Albany, Atlanta, Baltimore, Boston, Bridgeport, Buffalo, Chicago, Cincinnati, Cleveland, Columbus, Dallas, Detroit, Hartford, Honolulu, Houston, Indianapolis, Johnstown, Pa., Kansas City, Mo., Los Angeles, Milwaukee, Nashville, New York, Philadelphia, Pittsburgh, Portland, Ore., St. Louis, St. Paul, Salt Lake City, San Antonio, San Francisco, Savannah, Seattle, Syracuse, Toledo, Tulsa, Washington, Wilkes-Barre, York. *Export Distributor:* Bethlehem Steel Export Corporation, New York.

BETHLEHEM STEEL COMPANY

AIR^{n}

HEATING AND AIR CONDITIONING TO THE N^{th} DEGREE

Serving HEATING AND AIR CONDITIONING FROM 70 OFFICES IN THE UNITED STATES

Architects, engineers, and contractors will find within the Trane organization the answer to all their equipment and service requirements

A staff of specially trained technical men at each office.

Equipment that meets every requirement whether in a giant industry or a small home.

A record of notable installations the world over.

Training Air—to heat it, to cool it, to cleanse, humidify and to dehumidify it, to improve ventilation.

Summing it all up—Trane Related Units make possible the N^{th} degree in Heating and Air Conditioning. The Trane Company, 2005 Cameron Avenue, La Crosse, Wis.

THE TRANE COMPANY

ALSO TRANE COMPANY OF

HEATING
COOLING
VENTILATING
CLEANSING
HUMIDIFYING
DEHUMIDIFYING

The HAND of TRANE

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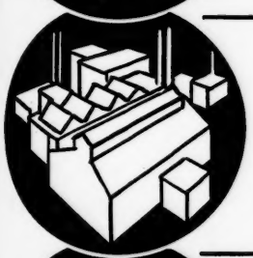
HEATING SPECIALTIES AND
NON-FERROUS CONVECTORS



COMFORT AND PROCESS
AIR CONDITIONERS

UNIT HEATERS AND
UNIT VENTILATORS

EVAPORATIVE CONDENSERS
AND PUMPS

BLAST COILS
AND COOLING COILS

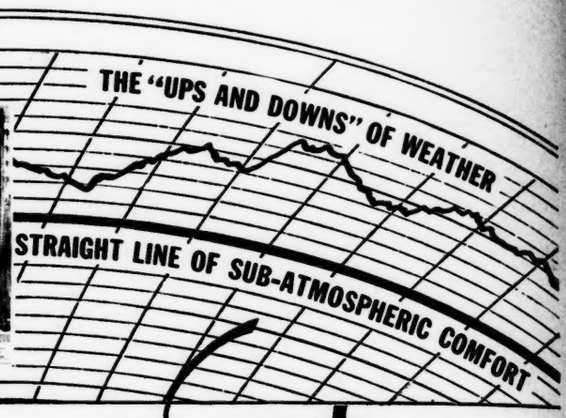
AIR^n *is a symbol used exclusively by TRANE to signify the Nth degree of excellence in Heating, Cooling, and Air Conditioning equipment.*

LACROSSE, WISCONSIN

CANADA LTD., TORONTO, ONT.

THE COMMODORE
NEW YORK CITY

Comfort Conditioned BY DUNHAM



Sub atmospheric Steam

••• MEETS THE CHANGING CONDITIONS OF WEATHER BY CONTINUOUSLY CIRCULATING STEAM AT TEMPERATURES CORRESPONDING TO THE VARIABLE RANGE OF PRESSURES ABOVE AND BELOW ATMOSPHERE

DUNHAM Differential HEATING

HEATING

Through the silent circulation of steam, matched in temperature to precise weather requirements—Commodore guests . . . as do occupants of all Dunham "Comfort-Conditioned" buildings . . . enjoy ideal warmth no matter how widely or rapidly winter weather changes. They are comfortable in frigid "snaps" . . . equally comfortable in mild "spells" . . . and during mild periods they are never exposed to the stifling over-heating effect of "pressure" steam.

Dunham Sub-atmospheric Steam Heating—subject to manual control for the moderate size building, full-automatic for the larger project, contributes in addition to the tangible value of Comfort, an important financial aspect. For this system . . . in all weathers . . . without variance . . . performs at a hitherto unattainable degree of economy.

Many Vacuum Return line systems as was the Commodore have been Comfort-Conditioned by Dunham without replacement of steam source, piping or radiation.

May we send the interesting brochure "Cool Steam?"

Consult the Architect for good design and the Consulting Engineer for mechanical equipment.

C. A. DUNHAM COMPANY

450 EAST OHIO STREET, CHICAGO

Over 80 Sales Engineers in the United States, Canada and the United Kingdom serve "Dunham Heating Service" at close at your telephone. Consult your classified telephone directory for the address in your city.

Old Cap Carter

puts a steel mill to work

A million American dinners tonight, of delicious deep-sea fish, would never be eaten except for steel. First the old fisherman must mend his nets with a steel needle. Then he puts to sea in a steel boat, unloads his catch into a steel trough, cleans and prepares the fish with steel implements, and finally ships the fish in steel cans plated with tin.

Last year American housewives opened many thousands of tons of these cans . . . you could almost say we would be without sea food if it were not for steel.

In the lives of every one of us, steel plays a vital part. That fact is never for a moment forgotten at Youngstown, and research goes on continuously, to keep down the costs and increase the value of the countless steel products you use every day. That is why you, the user of Sheets and Pipe, can always *depend on Youngstown.*

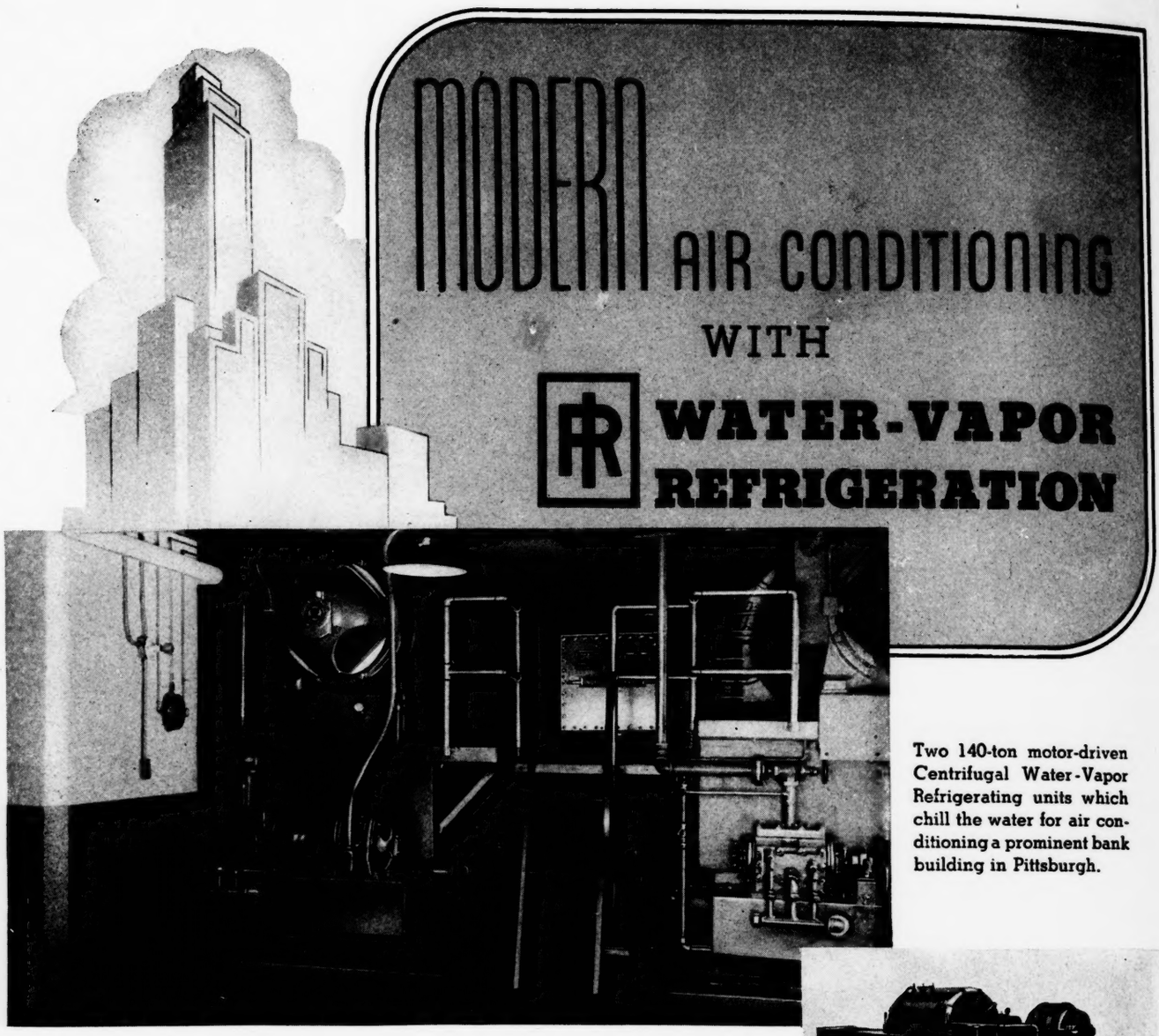
THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon and Alloy Steels
General Offices - YOUNGSTOWN, OHIO

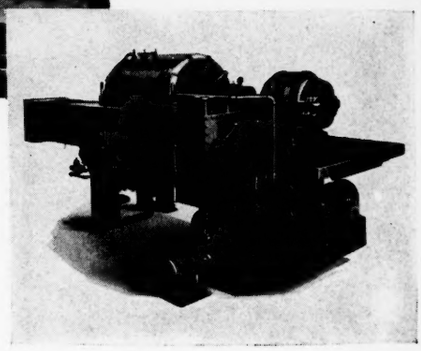
Sheets - Plates - Pipe and Tubular Products - Conduit - Tin Plate - Bars Rods - Wire - Nails - Unions - Tie Plates and Spikes

QUALITY V YOUNGSTOWN SERVICE

25-3A



Two 140-ton motor-driven Centrifugal Water-Vapor Refrigerating units which chill the water for air conditioning a prominent bank building in Pittsburgh.



Centrifugal Water-Vapor Refrigerating units are built for capacities from 100 tons refrigeration upward for either motor or steam turbine drive. The Steam-Jet Cooler type (not shown) is built in sizes from 15 tons upward for operation with steam pressures of 2 lbs. gauge or higher.

Modern air conditioning demands the most modern refrigerating equipment. Ingersoll-Rand has developed equipment differing basically from all previous practice to meet the severe requirements.

Consider these outstanding advantages:

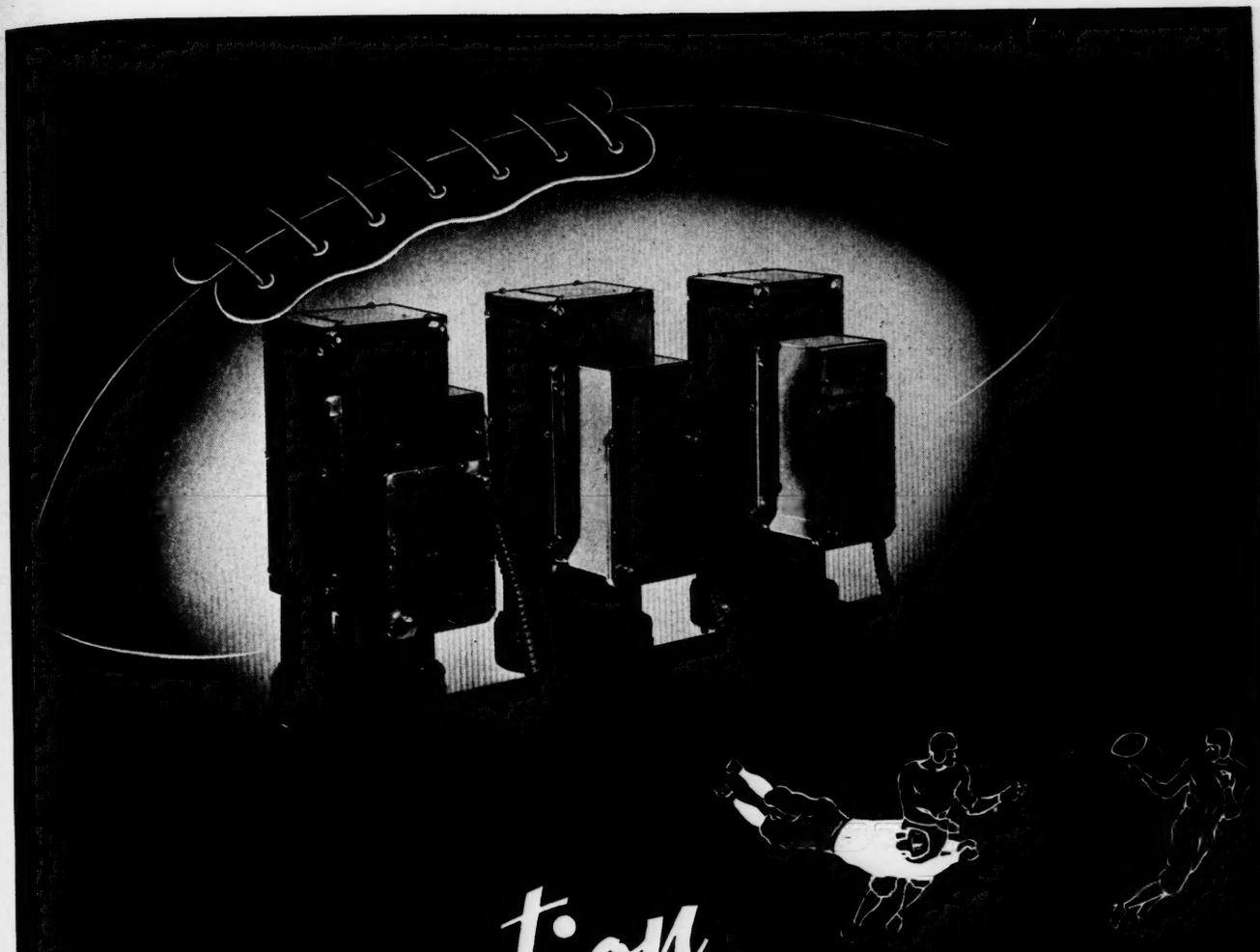
- **Water is the only refrigerant**
- **Full capacity for life**
- **Unusual overload capacity**
- **Units may be installed wherever convenient (in one case, on the 58th floor of a New York skyscraper)**
- **Flexibility—day by day**
- **Self-regulation with load**
- **Low operating cost**

The use of water as the only refrigerant eliminates the leakage, storage and yearly replacement cost often encountered with systems using other refrigerants. Building owners are relieved from restrictive ordinances governing the use and storage of such refrigerants.

Builders of Cameron Pumps, Condensers, Vacuum Pumps, Compressors, Blowers, Diesels, Rock Drills and Pneumatic Tools.

Ingersoll-Rand

11 BROADWAY, NEW YORK, N. Y.



Continuation

BARBER-COLMAN COMPANY • ROCKFORD, ILL.

GOOD W-N NEWS

FOR BUYERS OF UNIT HEATERS

"QUIETEST UNIT"

SPECIAL-DESIGN FANS, RUBBER-ISOLATED MOTORS, AND CAREFUL SELECTION PRODUCE W-N QUIETNESS

FOR YOUR installations where *quiet operation* is essential, certain sizes of Webster-Nesbitt unit heaters are offered in the belief that when you have heard them, you, too, will call them quietest of units.

Many factors contribute to Webster-Nesbitt quietness: years of experience in the manufacture of air-handling equipment; fans with especially wide, overlapping blades of gradual pitch, designed to eliminate the eddy-current and blade-tip noises common to ordinary propeller fans; proper spacing between fan and heating element, to provide a more uniform, quieter air flow; rubber-isolated, slow-speed motors, to prevent the transmission of hum and vibration to unit casing and connected piping; care in selecting the right unit for the job—an assistance which every Warren Webster representative is prepared to render.

Webster Nesbitt

UNIT HEATERS

The good-looking Webster-Nesbitt units circulate more air, at lower temperature, than do most other units of the same B.t.u. rating. They discharge the air at high velocity down into the desired area, assuring proper air mixture, elimination of stratification, quick heating, comfort for occupants, and many dollars of fuel saving. Add to this the economic factor of *quiet operation*, and you have every good reason for choosing Webster-Nesbitt unit heaters for your next installation.

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Manufactured by JOHN J. NESBITT, INC., Holmesburg, Phila., Pa.
Distributed Exclusively in the U.S.A. by WARREN WEBSTER & COMPANY, Camden, N. J.
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PROFIT *by studying displays like these*

A few Exhibits at the 4th International Heating and Ventilating Exposition

Engineers and Technical Men, concerned primarily with design and specifications... Operating Men, Plant Managers and Superintendents, responsible for the proper functioning of equipment . . . Executives, Building Managers and Contractors—all interested in seeing the latest equipment designed to solve their particular problems are looking forward to an important forthcoming event—the Fifth International Heating and Ventilating—Air Conditioning—Exposition.

Thousands of men will welcome this timely opportunity of studying the impressive displays of 300 leading manufacturers—seeing demonstrations of equipment that will satisfy the present-day demands for better living and working conditions—meet the exacting requirements of industrial operations.

You and your associates should certainly attend

FIFTH
INTERNATIONAL HEATING &
VENTILATING EXPOSITION
NEW YORK N.Y.
January 24-28-1938

Held under the auspices of American Society of Heating & Ventilating Engineers

The Air Conditioning Exposition

5th INTERNATIONAL HEATING & VENTILATING EXPOSITION

GRAND CENTRAL PALACE, JANUARY 24-28, 1938, NEW YORK, N. Y.

MANAGED BY INTERNATIONAL EXPOSITION COMPANY

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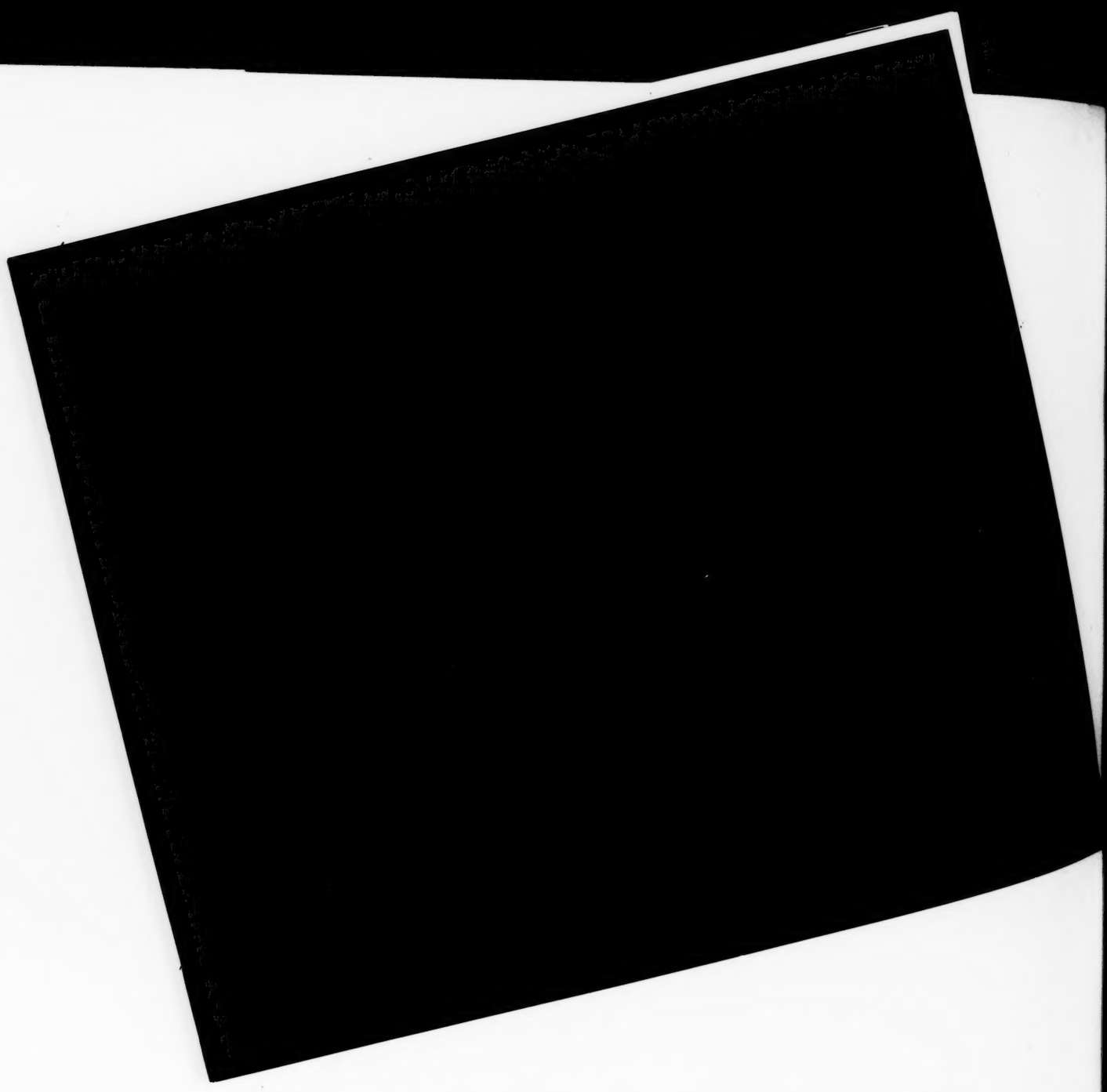


HEATING &

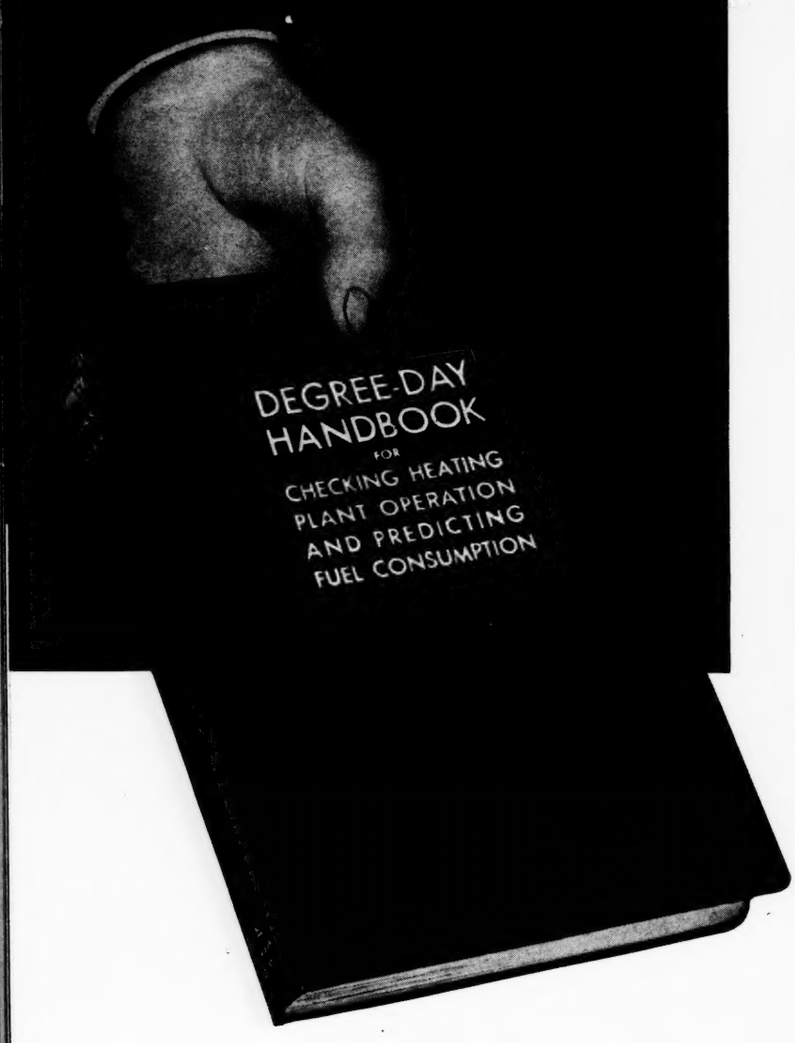
. . . the big event of the year for HEATING & VENTILATING. Rest assured that the publishers are making an effort to produce an interesting issue, an important issue, an issue of such value that it will live for the entire year to come!

In addition to the usual features of reviewing the current year's Progress and Achievements in (1) Winter Heating and Humidifying, in (2) Summer Cooling and Dehumidifying, in (3) Year 'round Ventilating and Air Cleaning, in (4) the All-season Essentials such as controls, instruments, etc.—in addition to these features, the Yearbook for January 1938 will include a comprehensive preview of the Exposition itself. All the highlights that attend the Exposition—the exhibits—the exhibitors—conventions—meetings and activities of important organizations—everything of interest pertaining to the Exposition will be completely covered in advance of the Exposition itself, so that he who attends may be guided. So that he who doesn't, may be thoroughly informed.

Every engineer—every contractor—every man active in furthering the developments of the Industry will need the next issue of HEATING & VENTILATING. He'll use it as he does his own handbook throughout 1938 . . . he'll apply in 1938 the Achievements made in 1937!

● Do your share to promote Progress: see that all your professional associates have copies reserved for themselves. Just mention to them that the next issue of HEATING & VENTILATING will be the Yearbook of Progress and Exposition Number—they'll make their own reservations. A postcard will do.

VENTILATING
AIR CONDITIONING



DEGREE-DAY HANDBOOK

A NEW BOOK FOR CHECKING HEATING PLANT OPERATION AND PREDICTING FUEL CONSUMPTION

300 Pages of Useful Information and Data, with Answers to Practical Questions Confronting Heating and Air Conditioning Engineers Every Day

Answers Questions Like These

How is the degree-day used in predicting the amount of fuel required for heating buildings in different localities throughout the United States?

Do you know of a simple, practical method of checking the operating efficiency of one heating plant against that of another?

If a comparison of one heating season with another showed a decided increase in fuel consumption, actually due to a lower average temperature but thought to be caused either by a change in fuel quality or in heating plant efficiency, could you defend the fuel or the heating plant against the false charges?

How can a fuel dealer or a manufacturer of heating equipment show a customer, by means of the degree-day, just why one heating season required more fuel than another?

Are there cities or towns in, say, New Mexico, where a given type and size of heating plant requires more fuel than a similar plant in New York City?

Can you estimate from an architect's plans the amount of fuel required to heat the building shown?

How much coal, coke, oil, natural gas or manufactured gas is required per degree-day when heating with steam? hot water? warm air?

What is the lowest temperature ever recorded officially in your locality? and the highest?

Do you know how the degree-day is being used effectively by fuel dealers and heating equipment manufacturers in sales and other promotional work?

In your locality, how many hours during the summer months is the temperature above 75 degrees? above 85 degrees? above 95 degrees?

Do you know that the new Degree-Day Handbook contains 43 pages of worked-out examples showing just how the degree-day is being used for solving heating problems in various types of buildings?

SEE CONTENTS ON NEXT PAGE

Contents of New Degree-Day Handbook

Temperature Terms Used by Weather Bureau
Definitions of terms are placed on pages 1 and 2 where they may be found readily.

Symbols Used in Formulas
The notations or symbols for formulas are on pages 3 and 4 to facilitate reference.

What the Degree-Day is
Brief explanation followed by descriptions of degree-day tables and other temperature-reference tables. Various applications are shown by 46 examples.

Table 1. Degree-Day (65° Base) in a Normal Heating Season
Used for predicting fuel consumption in 1064 cities—values expected under normal conditions and computed from 20- to 50-year average mean temperatures.

Table 2. Degree-Days for Cities Near Weather Bureaus
Includes cities for which degree-day data are not available—shows nearest city in Table 1 with degree-day data.

Table 3. Degree-Days for Recent Heating Seasons
Table 1 is based upon 20- to 50-year averages; Table 3 applies to recent years.

Table 4. Degree-Days for Industrial Heating
For buildings maintained at less than 70 degrees, such as plants, mills, and other industrial or commercial buildings.

Table 5. Heating Values of Fuels
Table includes oil, gas, coal, coke, lignites, and wood.

Table 6. Heat Equivalents for Steam and Electricity

Table 7. Coal or Coke Required per Degree-Day
Data applies to steam, hot water and warm-air plants of various efficiencies.

Table 8. Oil Required per Degree-Day
Includes steam, hot water and warm-air plants of various efficiencies.

Table 9. Manufactured Gas Required per Degree-Day
Table includes steam, hot water and warm-air plants of various efficiencies.

Table 10. Natural Gas Required per Degree-Day
Table includes steam, hot water and warm-air plants of various efficiencies.

Table 11. Minimum, Maximum and Design Temperatures, and Heating Season Data
Includes recommended design temperatures; record high and low temperatures; and normal heating season data for 411 cities throughout the United States, including length of season, beginning and ending dates and average temperature for season.

Table 12. Figures Used in Predicting Fuel Consumption by the Fuel-Constant Method

Table 13. Heat-carrying Capacities of Air Systems per Square Inch of Duct Area
Applies to gravity, warm-air, forced warm-air, and hot-blast systems.

Table 14. Overall Seasonal Efficiencies of Various Types of Fuels

The Degree-Day as a Guide to Operating Efficiency
Examples showing practical application of the degree-day in institutional plants, commercial buildings, school buildings, and use of degree-day by district heating companies.

The Degree-Day in Customer Relations Work and Sales Promotion
Application of the degree-day in promoting the sale of gas, coal, and oil and in answering questions relating to variations in fuel consumption.

Using the Degree-Day in Market Research

How the Base Temperature is Established
Explains why most of the degree-day data in the Handbook have been established with reference to a base temperature of 65 degrees.

Use of Degree-Day in Predicting Fuel Consumption

Summer Cooling Data for 18 Cities

ORDER FORM

HEATING & VENTILATING, 148 Lafayette St., New York

Send me, postpaid, a copy of the new DEGREE-DAY HANDBOOK. Within 5 days after receipt of book I will either send you $3 or return the book—or I enclose $3 herewith.

NAME.....

HOME ADDRESS.....

CITY AND STATE.....

FIRM.....

*POSITION.....

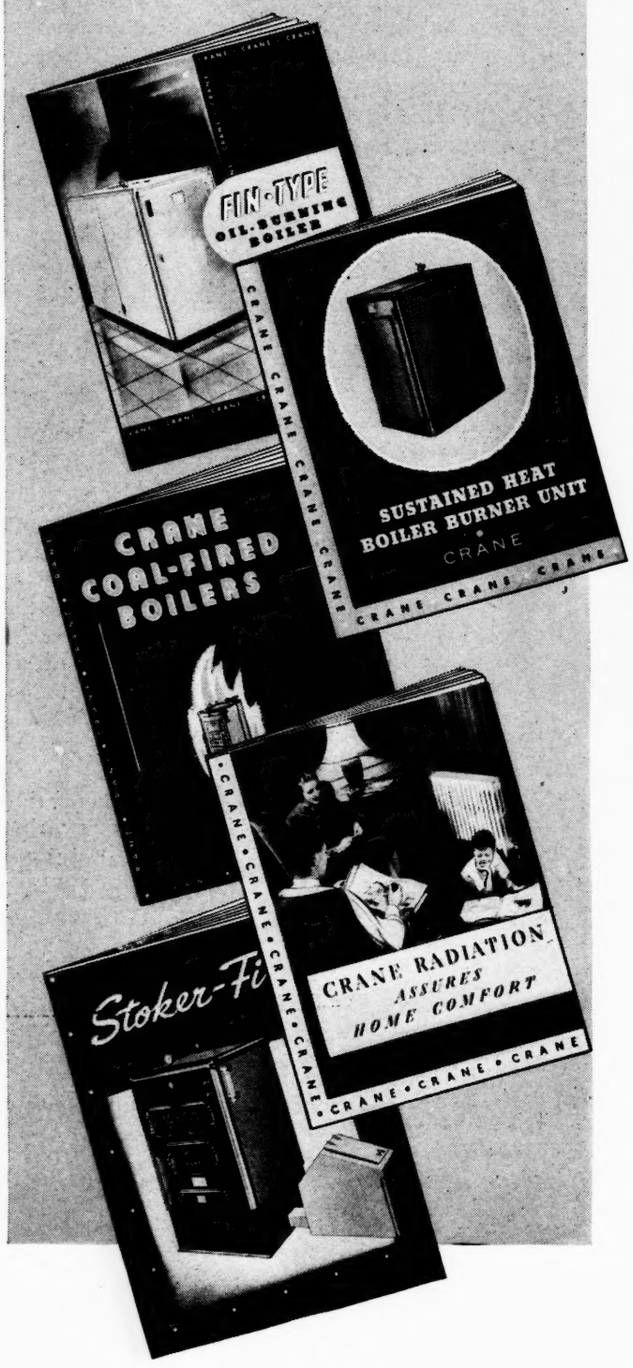
*This additional information for our private records would be appreciated.

Book Sent On Approval Without Advance Payment

Price $3.00

Crane Boilers for Every Fuel

BACKED BY "SURE-FIRE" SALES HELPS



● Whether the fuel is coal, oil or gas—the system hot water, steam, vacuum or vapor—regardless of the size of the home, there is a Crane Boiler designed just to suit that situation. Heating contractors recognize that customers accept, without question, the high quality of a heating system carrying the name Crane. The advantages of a single source of supply for all items of heating equipment: boilers, radiators, convectors, valves, fittings and piping, are obvious.

Back of the complete Crane line is an extensive and consistent promotional campaign which many dealers the country over are using to help them sell more heating equipment—to make more profit.

It will pay you to ask the Crane Salesman to tell you more about Crane Complete Heating.

●

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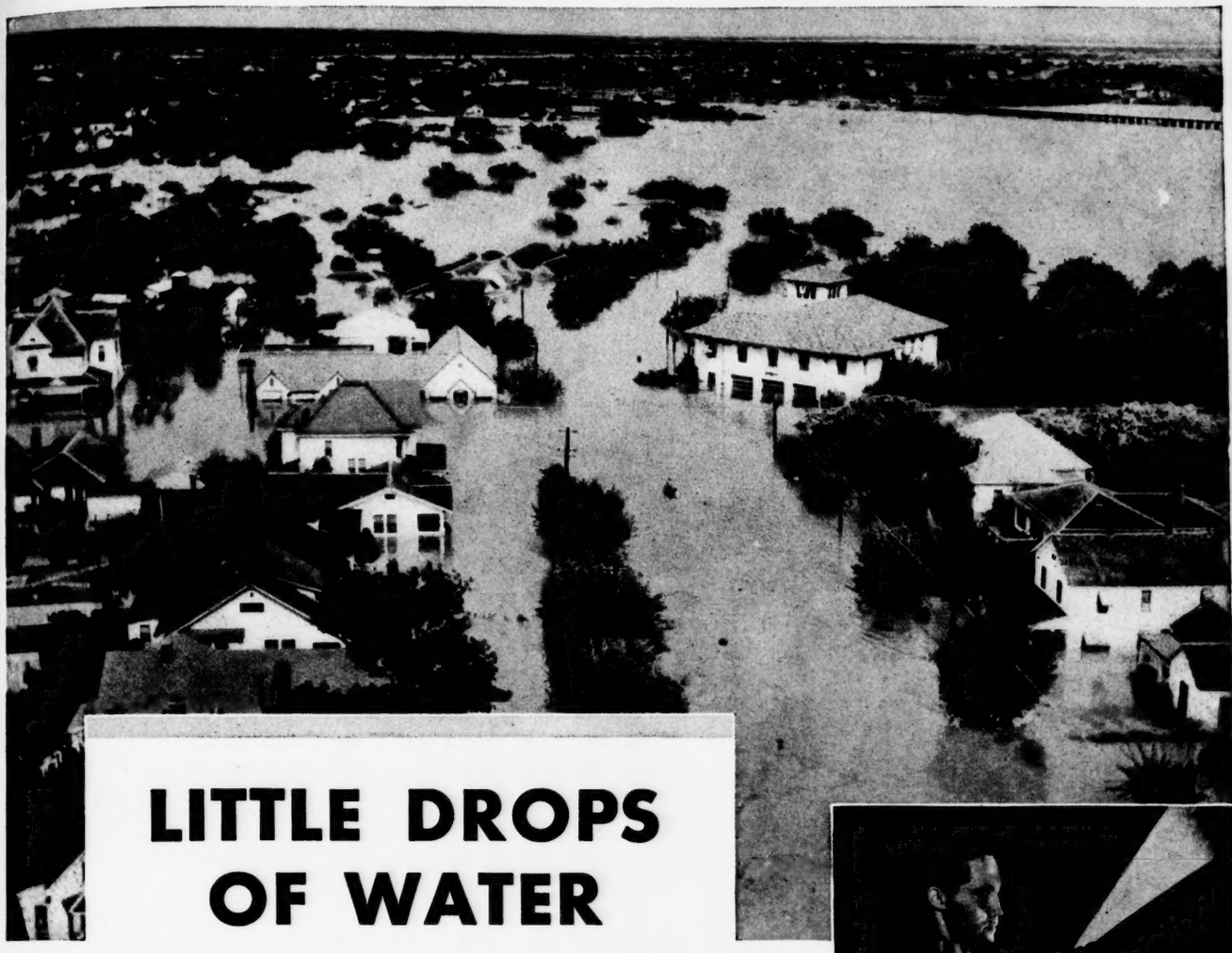

LITTLE DROPS OF WATER

can make oceans of trouble for air conditioning equipment, too!

U·S·S *Copper Steel Galvanized Sheets have double the atmospheric corrosion resistance of plain galvanized sheets and cost but little more.*

MILLIONS of tiny particles of moisture continually bombard the walls of air conditioning equipment. They seek out any weak spot and attack it with all the forces of corrosion. It takes steel with a double line of defense to withstand this onslaught for long periods of time.

Metallurgists have found that a proper percentage of copper in the steel, plus good galvanizing, more than doubles its resistance to atmospheric corrosion. The value of the increased life of ducts, grills, fans, housings and other exposed equipment, due to the addition of copper, is far greater than its slightly higher cost.

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NOW FOR EITHER . . . . . LINE OR LOW VOLTAGE

"GENUINE DETROIT" THERMOSTATS

No. 211 for Low Voltage
No. 311 for Line Voltage

Straight line temperature control, eliminating "cold 70"

Applicable to both heating and cooling

With or without heat compensation

For use on two- or three-wire circuits, low voltage only

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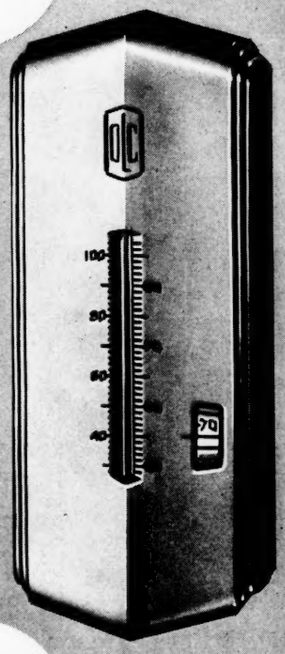
Available also in summer and winter, or day and night types, in low voltage only



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Accurate up to 100% relative humidity

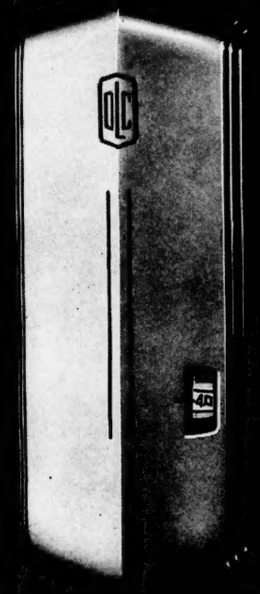
Controls either humidification or dehumidification

No flutter nor danger of corrosion of contacts

Both instruments attractively styled for modern interiors

Low voltage Humidistat and Thermostat carried on an attractive dual mounting plate if desired

Not vulnerable to dust accumulation



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Electrical Load Ratings—

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A two position heat regulator that is ideal for the small home. It is sturdily made and dependability and precision are built right into it. A noiseless device that will outlast the heating plant.

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EXCLUSIVE CURTIS "CENTRO-RING" POSITIVE PRESSURE LUBRICATION PROVIDES REAL PROTECTION

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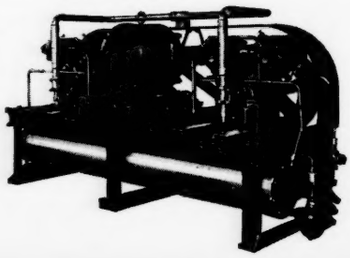
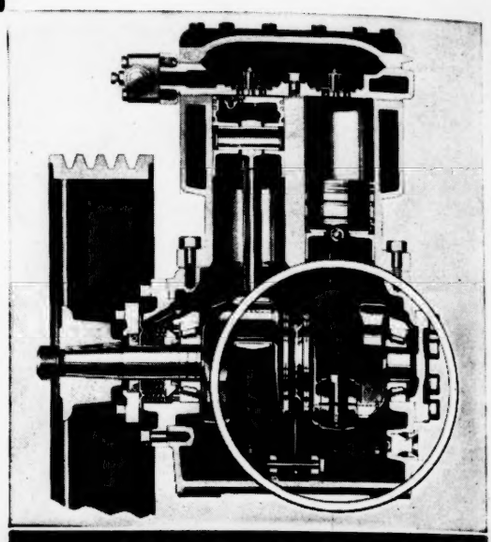
Engineering originality of this kind has been responsible for the wide use and acceptance of Curtis compressors and condensing units — for their low cost of upkeep and economical performance.

Write us for full details or call your local Curtis representative.





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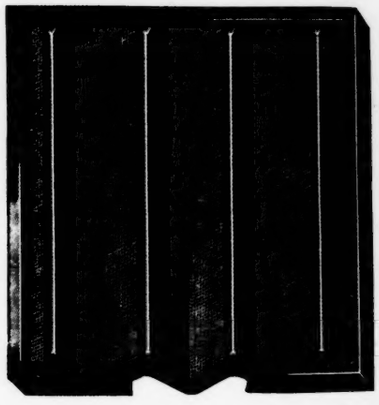
Non-absorptive

Full particulars on application



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Miller Mallets have a hard head which will not bounce yet possesses sufficient resiliency to prevent marring of metal surfaces. Made of a fibrous, laminated compound, they won't chip, crack or dry out. Handle is of the finest quality white ash.

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The selection of Young Unit Heaters will accomplish three objectives—direct more heat into the working area; eliminate drafts; maintain a constant healthful temperature with considerable saving in fuel costs. This line is graduated in sizes and capacities to permit the selection of the proper unit to do any specific heating job.
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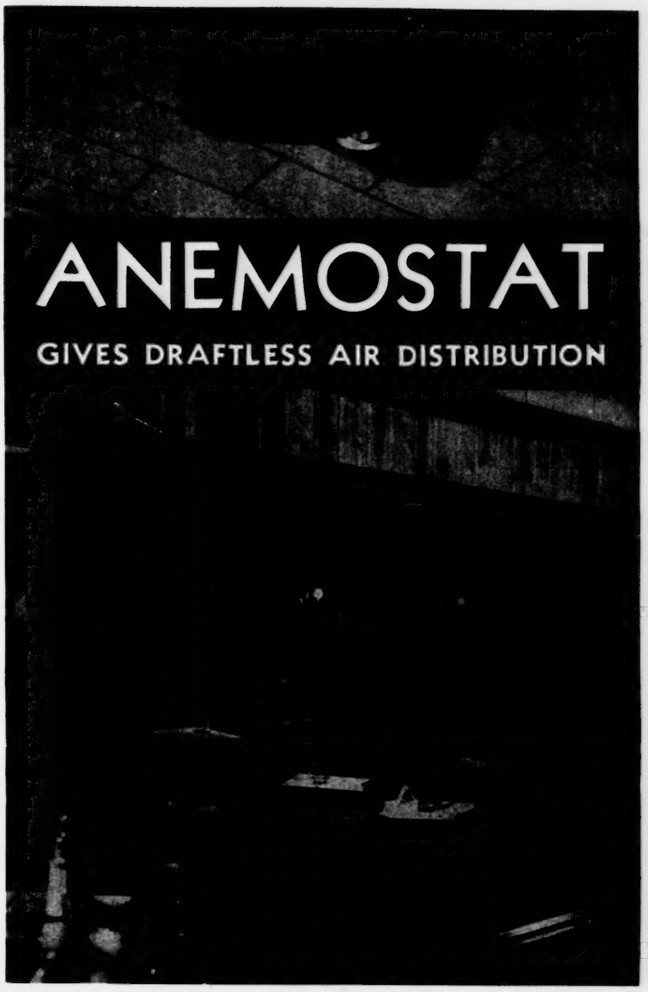

Air Conditioning Equipment by Fitzgibbons Boiler Co., Inc., New York, N. Y.
Contractors: Menke Air Conditioning Co., Newark, N. J.

Draftless Winter Air Conditioning

In Pal's Cabin, West Orange, N. J., the temperature difference, horizontally, throughout the rooms is not more than one-half of one degree and the owner can depend on it, because the Anemostat diffuses the conditioned air in such a manner that neither draft nor stratification or air pockets are possible.

INSTALLATION DATA:

Length of Room	53′	Volume of air distributed through each Anemostat	332 c.f.m.
Width of Room	29′	Temperature Differential	70°
Height of Ceiling	10′	Neck diameter of Anemostat	10″
Velocity in Anemostat neck	700 f.p.m.	Diameter of largest cone	25″

ANEMOSTAT HIGH VELOCITY AIR DIFFUSER

The ANEMOSTAT is an accepted scientific achievement. It has solved major problems of the Air Conditioning Industry by reducing the speed of air flow to such an extent that it is no longer perceptible as a draft. The ANEMOSTAT mixes room air with conditioned air within the device. Thus the predetermined room temperature is established considerably above the breathing level. The ANEMOSTAT permits greater temperature differentials, smaller ducts, smaller plants, lower installation and operation costs. The ANEMOSTAT can be applied to existing systems as well as to new installations.

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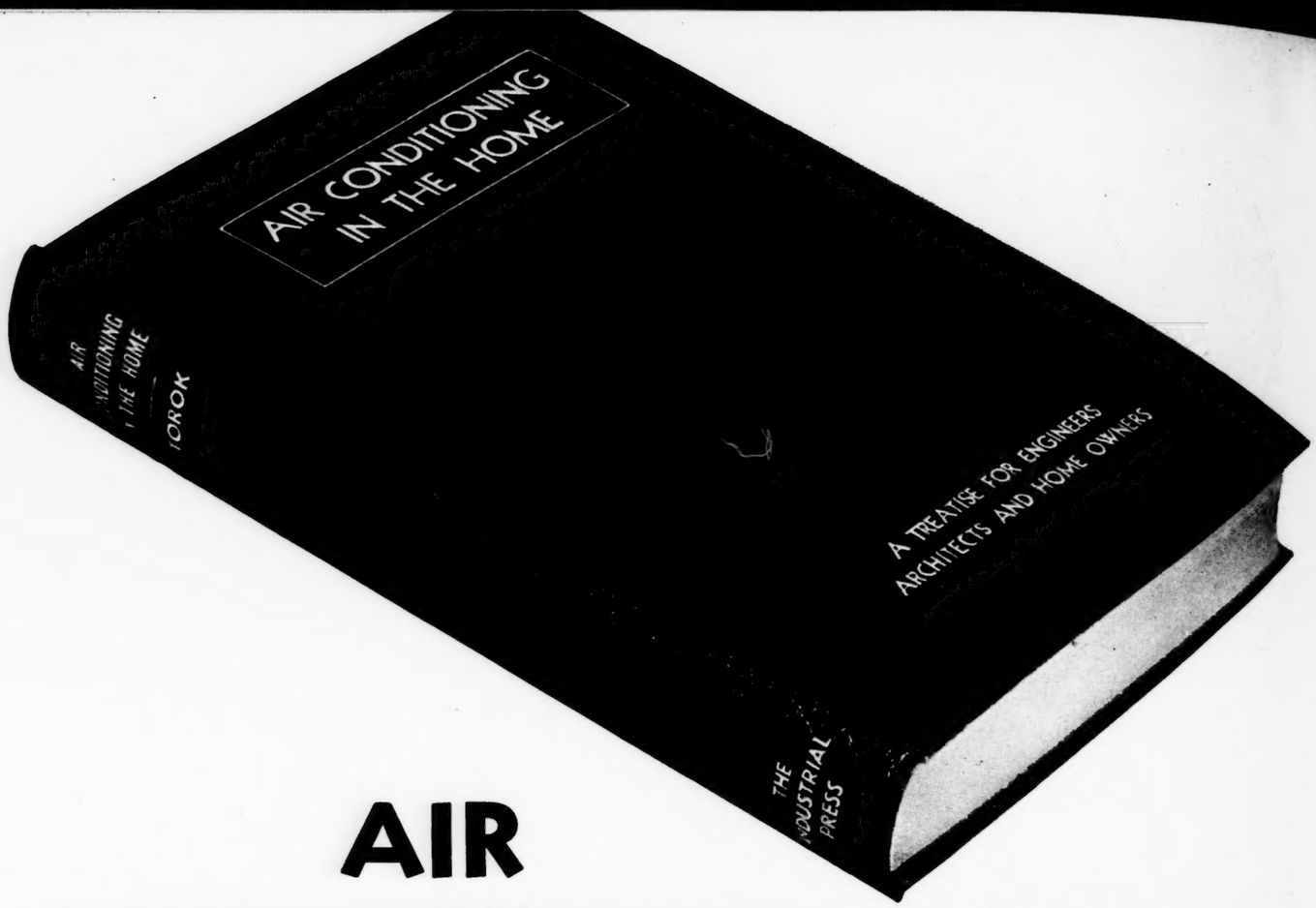
ANEMOSTAT
"No Air Conditioning System is better than its Air Distribution"



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A Treatise for Engineers, Architects and Home Owners

This new book explains the important advantages of air conditioning, the fundamental principles, the equipment and systems in use, and includes an unusual amount of definite data for everyone interested either in partial or complete air conditioning.

296 pages (6 by 9 inches) of practical information, 50 illustrations of different air conditioning units or systems, 39 tables of useful data.

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- FUNCTIONS OF AIR CONDITIONING SYSTEMS
- AIR CONDITIONING EQUIPMENT
- AIR CONDITIONING SYSTEMS
- INSTALLATION AND OPERATION
- PRINCIPLES OF AIR CONDITIONING
- PSYCHROMETRIC TABLES FOR AIR CONDITIONING CALCULATIONS
- EXAMPLES ILLUSTRATING USE OF PSYCHROMETRIC TABLES
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Send me, postpaid, a copy of the new book Air Conditioning in the Home. Within 5 days after receipt of book I will either send you $3 or return the book—or I enclose $3 herewith.

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*This additional information for our private records would be appreciated.

H&V-12/37

marks the spot

WHERE FUEL SAVINGS BEGIN

When steam traps leak—tons of coal filter through the small neck of the system every year. When they bind, money is lost and service complaints are frequent.

Sarco Thermostatic Traps differ at this point from all others—the Sarco Bellows—never duplicated—can be tested hydrostatically up to 75 pounds on low pressure systems, and is made for service up to 200 pounds steam pressure on high pressure lines. It is powerful—yet very sensitive—and inexpensive; yet lasts for years.

There's a Sarco Trap for every kind of steam condensation removal service.

ASK FOR THIS NEW DATA BOOK
—On your business letter-head. Shows how to hook up all types of heating, air conditioning and process equipment with suitable traps and control.

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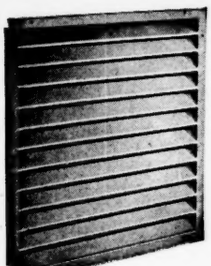
SARCO CANADA LIMITED, FEDERAL BLDG., TORONTO, ONT.



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ELGO SHUTTERS

AUTOMATIC BACK DRAFT DAMPERS for ducts. Increased efficiency for any fan or blower installation.

ELGO AUTOMATIC SHUTTERS for exhaust fans and blowers. Gravity action. Sensitive. Excellent protection against deterioration. Standard materials for exacting requirements.

ELCON ALL STEEL STATIONARY SHUTTERS welded into rigid unit. Rugged and durable. Provide perfect protection.

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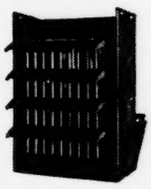
"Health-aire" UNIT HEATER COILS



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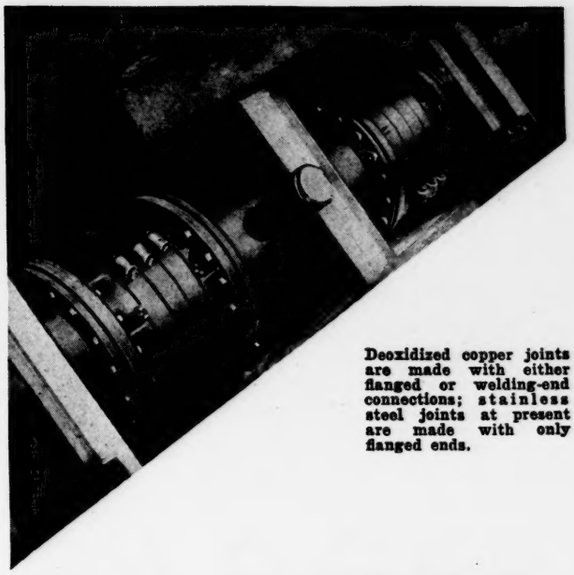

Deoxidized copper joints are made with either flanged or welding-end connections; stainless steel joints at present are made with only flanged ends.

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The Name that Goes with the Type

For many years the name BADGER has been associated with expansion joints of the corrugated type. It is today the name to use when specifying or buying these packless, non-servicing joints.

The name BADGER means a background of successive engineering steps that have improved both the quality and utility of this type of joint.

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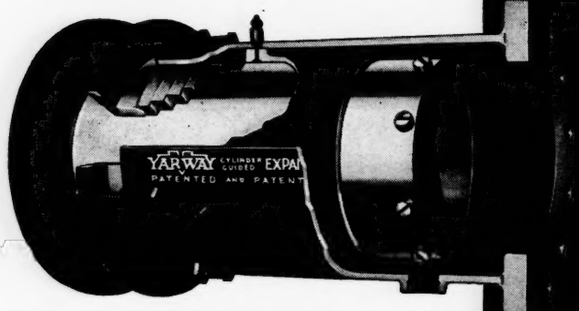
BADGER EXPANSION JOINTS

CYLINDER-GUIDED FOR TROUBLE-FREE SERVICE



Made in single or double end types with or without base.

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Welded Steel construction. Alemite lubrication. Diameter no larger than pipe flange... Outside cylinder guide design prevents abrasive sediment from cutting the sleeve. Write for catalog EJ-1904, which describes both Gland-Pakt and revolutionary Gun-Pakt (packed under pressure) types.

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THIS BEAR TRAP IS PRETTY GOOD AT CATCHING BEARS

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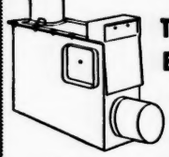

THIS CONDENSATION ELIMINATOR . . . .

is just as good at trapping excessive moisture which would otherwise cause chimney cracks, salt deposits, necessitating repairs and sometimes stack replacement. Specify the Condensation Eliminator on all installations.

Patented

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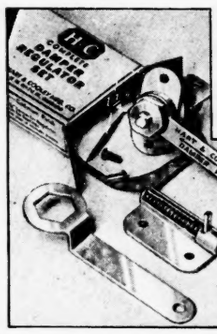

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- Dampers are held securely, no turning, end-play or vibration.
- Can be installed in any position — near edge of duct — on round or flat duct.
- Handle always indicates position of damper — may be removed to prevent tampering with adjustment.
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- Made in ¼" (No. 50¼) and ⅜" (No. 50⅜) sizes. ¼" snap end bearing permits easy installation of small dampers without bending.
- See them at your jobbers' or write for free sample.

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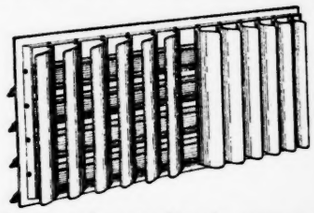

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Sturdiness of construction, architectural beauty and infinitely perfect diffusion are combined so effectively that a money-back pledge guarantees satisfaction.

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TEMPERATURE INSTRUMENTS

Industrial and Laboratory Thermometers — Trerice Recorders — Trerice Regulators

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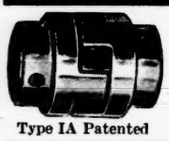
L-R *everlasting* **FLEXIBLE COUPLING**



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Type IA is unbeatable for small machines. Comes 3/16" to 2¼" bores. Quiet. No lubrication. Write for details.

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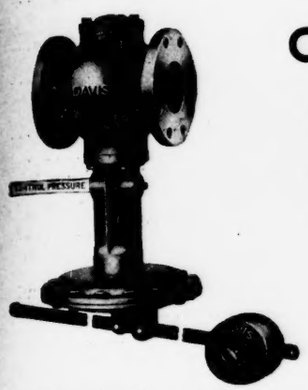
Use DAVIS No. 15 on Vapor Heating Systems



for Sensitive Low Pressure Regulation

SATISFACTORY operation of low pressure vapor heating systems invariably depends on the sensitivity and accuracy of the reducing valve that supplies steam to the system.

That's why Davis has designed and built the No. 15 balanced valve counterweighted diaphragm type regulator. It gives you accurate control regardless of supply pressure variations. Packing boxes are eliminated; hence no leakage, no stem friction. Excessive counterweighting is avoided by use of interchangeable diaphragm heads of calibrated sizes. Write for complete information.

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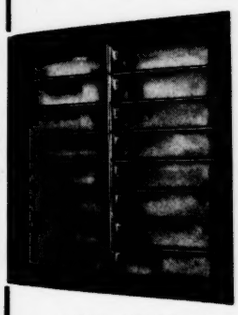

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BALL BEARING — ALL ALUMINUM

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AIR CONDITIONING PRODUCTS CO.
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AN ALL PURPOSE AIR VELOCITY METER

("ALNOR" VELOMETER)

Instantaneous, Direct Reading Air Velocity Meter, 20 FPM to 18,000 FPM

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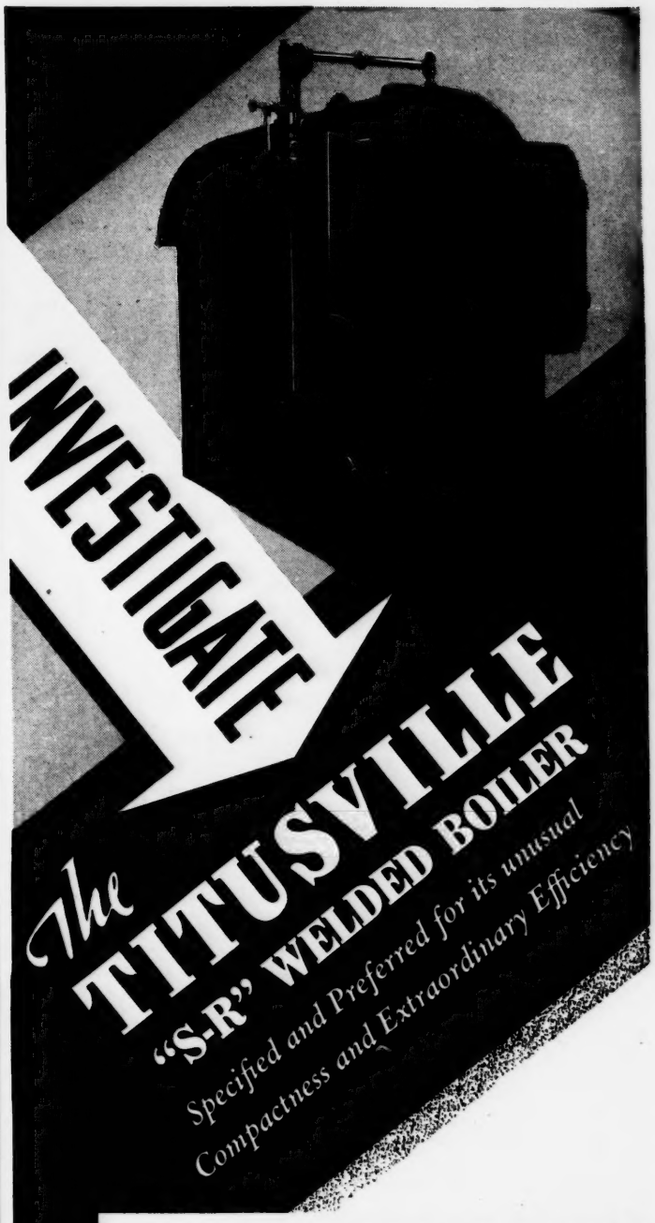
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The TITUSVILLE
"S-R" WELDED BOILER
Specified and Preferred for its unusual Compactness and Extraordinary Efficiency

Furnace installation is reduced to its simplest terms with the Titusville Series S-R Welded Boilers. Built with the Titusville self-cleaning, self-supporting firebox, this master-designed coal burning furnace can be very conveniently installed as one unit.

Titusville "S-R" Boilers are of the 3-pass type assuring high heat transfer and low temperature stack gases. Moreover, all heating surfaces are under water, making this Titusville unit most effective for steam production.

Get in touch with your nearest Titusville office or write direct for descriptive Bulletin No. 9090.

The TITUSVILLE IRON WORKS CO.
Division of Struthers-Wells Titusville Corporation
TITUSVILLE, PA.

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BY A MANUFACTURER-APPOINTED BOARD OF GOVERNORS

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Ralph K. Smith
PRESIDENT

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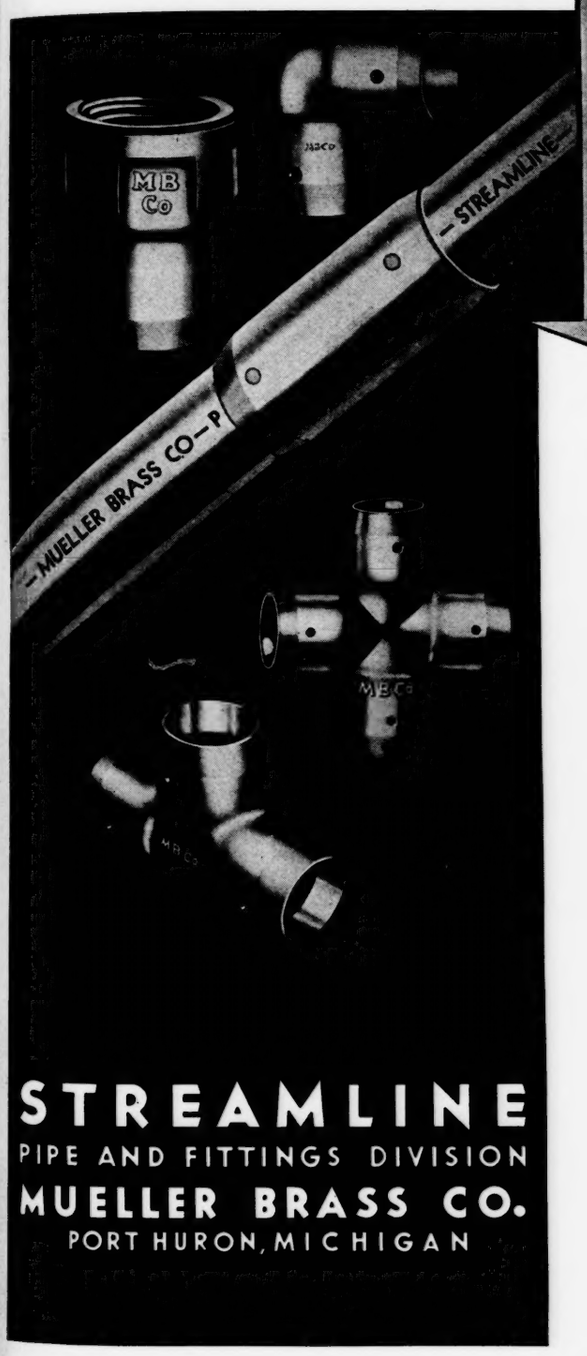
Copper PIPE *and* FITTINGS

for MODERN HEATING *and* AIR CONDITIONING



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